SP-1 Spirometry Unit

Service Handbook

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July1998 *Article Number: 2. 540 011*

SP-1 Service Handbook

Article Number 2. 540 011

Issue 1: March 1996

Issue 2: July 1998, Update and revision to incorporate latest hardware and software.

Associated Documents

Guide to SCHILLER Interpretation and Measurement Program E / D / F	Article No.	2. 510 179
SCHILLER SP-1 USER GUIDE - English / German	Article No.	2. 510 196
SCHILLER SP-1 USER GUIDE - French / Italian	Article No.	2. 510 197
SCHILLER SP-1 USER GUIDE - Spanish / Portuguese	Article No.	2. 510 103

CE 0124 93/42/EEC Medical Devices: 0124
'Notified Body' DEKRA AG

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DECLARATION OF CONFORMITY

Diagnostic System :	**Spirovit SP-1**
Serial numbers starting with:	040.
Year of manufacture:	1997 Onwards

We, the undersigned, hereby declare that the medical device (class IIa) specified above conforms with the essential requirement listed in Annex 1 of EC Directive 93/42/EEC.

This declaration is supported by:

Certificate of approval No.:	11425-01	ISO 9001 (REV. 1994) EN 46001 by SQS
	45112-60-01	ISO 9001/08.94 EN 46001 / 12.93 by DEKRA and
	45112-16-01	Annex II, Section 3 of the directive 93/42/EEC

CE 0124

Baar (Switzerland) Dated 30.06.1998

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Warranty

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The SCHILLER SP-1 is warranted against defects in material and manufacture for the duration of one year (as from date of purchase). Excluded from this guarantee is damage caused by an accident or as a result of improper handling. The warranty entitles free replacement of the defective part. Any liability for subsequent damage is excluded. The warranty is void if unauthorized or unqualified persons attempt to make repairs.

In case of a defect, send the apparatus to your dealer or directly to the manufacturer.

The manufacturer can only be held responsible for the safety, reliability, and performance of the apparatus if:

° assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by him, and

° the unit and approved attached equipment is used in accordance with the manufacturers instructions.

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Safety Notices

TO PREVENT ELECTRIC SHOCK DO NOT DISASSEMBLE THE UNIT. NO SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL ONLY.

DO NOT USE THIS UNIT IN AREAS WHERE THERE IS ANY DANGER OF EXPLOSION OR THE PRESENCE OF FLAMMABLE GASES SUCH AS ANAESTHETIC AGENTS.

IF THE DISPLAY IS DAMAGED, A LEAKAGE OF FLUID MAY OCCUR. DO NOT INHALE THE VAPOUR FROM THIS FLUID AND AVOID CONTACT WITH MOUTH AND SKIN. IF CONTACT IS MADE, CLEAN CONTAMINATED AREA IMMEDIATELY WITH FRESH WATER.

THIS PRODUCT IS NOT DESIGNED FOR STERILE USE.

SWITCH THE UNIT OFF BEFORE CLEANING AND DISCONNECT FROM THE MAINS.

DO NOT, UNDER ANY CIRCUMSTANCES, IMMERSE THE UNIT OR CABLE ASSEMBLIES IN LIQUID.

DO NOT OPERATE THE UNIT IF THE EARTH CONNECTION IS SUSPECT OR IF THE MAINS LEAD IS DAMAGED OR SUSPECTED OF BEING DAMAGED.

DO NOT USE HIGH TEMPERATURE STERILISATION PROCESSES (SUCH AS AUTOCLAVING). DO NOT USE E-BEAM OR GAMMA RADIATION STERILISATION.

DO NOT USE SOLVENT CLEANERS

USE ONLY ACCESSORIES AND OTHER PARTS RECOMMENDED OR SUPPLIED BY SCHILLER AG. USE OF OTHER THAN RECOMMENDED OR SUPPLIED PARTS MAY RESULT IN INJURY INACCURATE INFORMATION AND/ OR DAMAGE TO THE UNIT.

THE SP-1 COMPLIES WITH EMC REGULATIONS FOR MEDICAL PRODUCTS WHICH AFFORDS PROTECTION AGAINST EMISSIONS AND ELECTRICAL INTERFERENCE. HOWEVER SPECIAL CARE MUST BE EXERCISED WHEN THE SP-1 IS USED WITH HIGH FREQUENCY EQUIPMENT.

IT MUST BE ENSURED THAT NEITHER THE PATIENT NOR THE ELECTRODES (INCLUDING THE NEUTRAL ELECTRODE) COME INTO CONTACT WITH OTHER PERSONS OR CONDUCTING OBJECTS (EVEN IF THESE ARE EARTHED).

WHEN NON-MEDICAL DEVICES ARE CONNECTED TO THE RS-232 INTERFACE ENSURE THAT BOTH UNITS ARE SECURELY CONNECTED TO THE SAME EARTH POTENTIAL.

WHEN OPERATING THE UNIT ON BATTERY AND SIMULTANEOUSLY USING NON.MEDICAL DEVICES, THE RS-232 INTERFACE MUST BE FULLY ISOLATED.

Safety Notices

BEFORE USING THE UNIT, ENSURE THAT AN INTRODUCTION REGARDING THE UNIT FUNCTIONS AND THE SAFETY PRECAUTIONS HAS BEEN PROVIDED BY A SCHILLER REPRESENTATIVE.

THE GUIDELINES FOR PATIENT ELECTRODE PLACEMENT ARE PROVIDED AS ON OVERVIEW ONLY. THEY ARE NOT A SUBSTITUTE FOR MEDICAL EXPERTISE.

THE SP-1 ECG UNIT IS PROVIDED FOR THE EXCLUSIVE USE OF QUALIFIED PHYSICIANS OR PERSONNEL UNDER THEIR DIRECT SUPERVISION. THE NUMERICAL AND GRAPHICAL RESULTS AND ANY INTERPRETATION DERIVED FROM A RECORDING MUST BE EXAMINED WITH RESPECT TO THE PATIENTS OVERALL CLINICAL CONDITION. THE RECORDING PREPARATION QUALITY AND THE GENERAL RECORDED DATA QUALITY, WHICH COULD EFFECT THE REPORT DATA ACCURACY, MUST ALSO BE TAKEN INTO ACCOUNT.

IT IS THE PHYSICIANS RESPONSIBILITY TO MAKE THE DIAGNOSIS OR TO OBTAIN EXPERT OPINION ON THE RESULTS, AND TO INSTITUTE CORRECT TREATMENT IF INDICATED.

What's in this Book

THE SERVICE PHILOSOPHY FOR ALL SCHILLER UNITS IS FAULT FINDING TO MODULE LEVEL. THE PURPOSE OF THIS BOOK IS TO PROVIDE ALL THE INFORMATION NECESSARY TO ENABLE THE SERVICE ENGINEER TO EFFICIENTLY LOCATE AND REPLACE A FAULTY MODULE. THIS BOOK ASSUMES NO DETAILED KNOWLEDGE OF THE SP-1 BUT DOES REQUIRE THAT THE SERVICE ENGINEER IS FAMILIAR WITH STANDARD WORKSHOP PRACTICES.

The book is divided into the following chapters:

Chapter 1 - Operating Elements

The purpose of this chapter is to provide an easy reference for all the main operator functions and to give a basic introduction to the SP-1. This chapter gives details of the operator controls with the operation and function of each key briefly explained. The information in this chapter provides a background to the operating functions only. Complete operating information is provided in the SCHILLER SP-1 Operating Manual.

Chapter 2 - Functional Overview

This chapter provides a functional overview of the SP-1 The functional description is supported by functional block diagrams.

Chapter 3 - Fault Diagnosis

This chapter provides a guide to locate a fault to module level. The diagnostics are presented in a logical sequence of fault finding algorithms and procedures. Illustrations are provided to support the text where needed.

Chapter 4 - Module Removal and Replacement

This chapter gives an overview of the physical construction of the SP-1 with the main physical attributes of the unit briefly described. The physical description is supported by illustrations showing the internal location of all modules. Removal and Replacement instructions for all replaceable modules are also provided in this chapter. Each procedure is autonomous with details of tools, jumper settings, adjustments, and settings or special requirements that are required before and after replacement. Functional checks that must be carried out after replacing a new module are also provided.

Chapter 5 - Adjustments

This chapter provides all adjustments and settings. Also detailed in this chapter are basic functional test procedures that can be performed to check the functioning of the unit.

Chapter 6 - Spare Parts

This Chapter provides the part numbers and reordering information for all replaceable modules. Also included in this chapter are details of any special test equipment or special tools required for adjustment or fault finding procedures.

Chapter 7 - Technical Data

The full technical specification of the SP-1 is given in this chapter.

Chapter 8 - Glossary

This Chapter explains all the acronyms and signal titles used in this book and in the SP-1 circuit diagrams.

What´s in this Book

Index

Circuit Diagrams & Board Layouts

The circuit diagrams and component layouts are provided for all boards. These details are provided for information only.

We Need Your Help

The philosophy of SCHILLER is one of continuous improvement. Our aim is to provide the user with the most up-to-date information and the latest technological developments. We reserve the right to revise this document and make changes or improvements at any time.

Your suggestions and comments are welcome. Please contact the SCHILLER Technical Documentation Department:

Fax +41 41 761 03 34

List of Symbols

Mains Supply

Battery Operation

Fuse

LCD Contrast

Potential Equalisation (common Ground)

Attention - General Warning Sign - see accompanying documentation

Type BF equipment - safe for external applications

Manufacturers Take-back guarantee for used batteries

O - Mains Power Off - mains supply disconnected from unit
I - Mains Power On - mains supply connected to unit

ON/OFF

Chapter 1
Operating Elements

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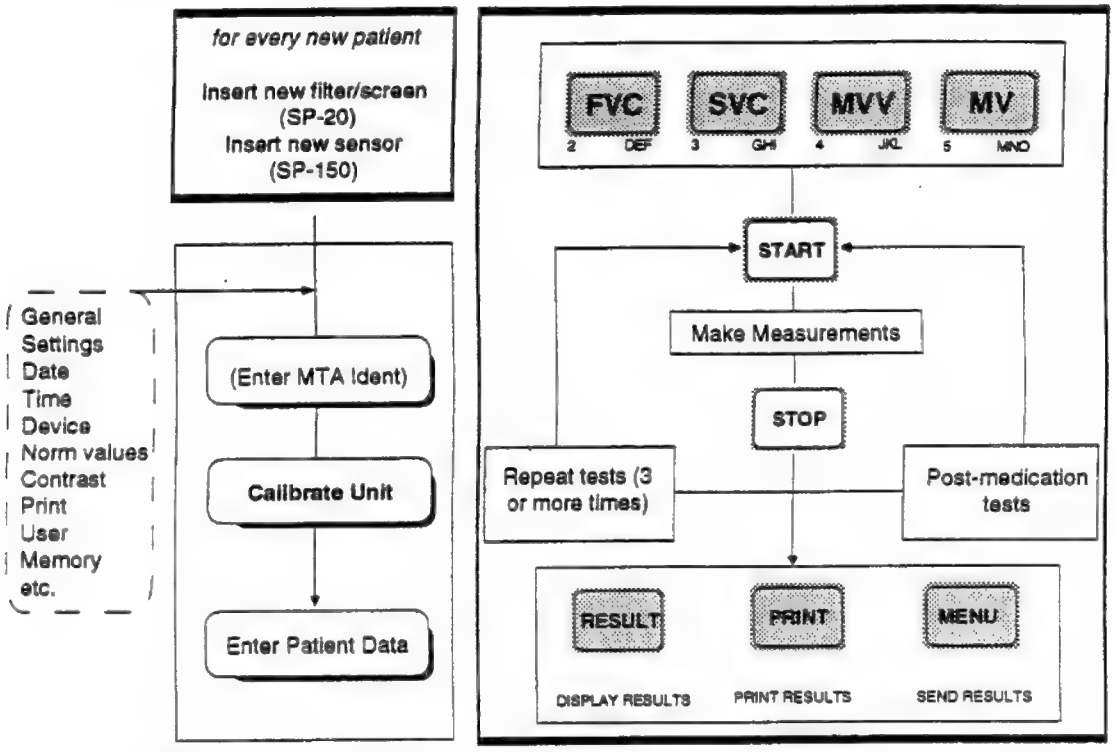
Procedure Overview



1 Switch ON

2 *Make Settings preference if required (remembered when unit switched off)*

3 Insert new screen/filter or sensor

4 Calibrate Unit

5 Enter patient data

6 *Select test*

7 Press START

8 *Patient Makes test*

9 Press STOP

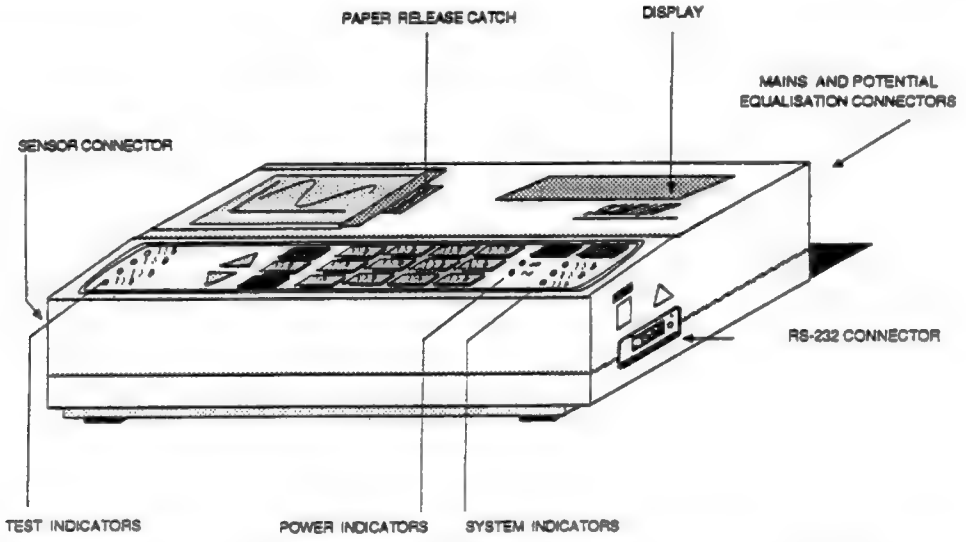
10 Repeat as many times as required (Best, or best two + last printed)

11 Display result

12 Print Result

13 Send result if required

Introduction



The SCHILLER SPIROVIT SP-1 is a stand-alone pulmonary function testing unit that features four modes for the measurement of inspiratory and expiratory values. The unit incorporates a liquid crystal display to instantly show the test results. An integral high quality thermal printer provides clear and comprehensive result analysis in a number of different formats and an RS-232 interface is provided for transmission of test results to a PC with the SEMA program. All tests and settings are initiated via an easy to use keypad with dedicated test keys. Test indicators show the current test being carried out and function LEDs provide visual indication for functions such as power, sensor disconnected, paper tray empty and paper jam. Measurements are made with a lightweight and hygienic open pneumotacho sensor. Two sensors are available. The SP-20 open pneumotacho sensor incorporates a disposable filter and is easily dismantled for cleaning and sterilisation. The SP-150 sensor has a disposable, single patient sensor/filter assembly eliminating the need to clean the sensor after each use. The SP-1 has the following features:

- Direct function keys for measuring the following:

  FVC Forced Vital Capacity

  SVC Slow Vital Capacity

  MVV Maximum Voluntary Ventilation

  MV Expired or Minute Ventilation

- Low weight and compact dimensions
- Built-in rechargeable battery for mains-independent use
- Selectable printing formats with integrated quality thermal printer
- Patient memory for up to 100 measurements (option)
- Choice of 6 languages for display and printing

Location

As with all medical units, the following general rules are to be noted:

- The unit should not be stored or operated in a wet, humid or dusty environment.
- The unit may not come into contact with acidic steams or liquids.
- The unit should not be set up near radiology or diathermic systems, or near large transformers or electrical motors. Ensure that a minimum distance of 1 meter between the unit and the mains supply is maintained

Potential Equalisation

In certain circumstances interference can be caused by external electrical equipment or radio equipment. Connect the earth potential equalisation connection at the back of the SP-1 to the hospital common ground or, if a common ground is not present, to a metal framework e.g. the bed frame. Note that all other electrical equipment in close proximity should also be connected to the same common ground. The part number of the potential equalisation cable is 2. 310 005.

Power Supply

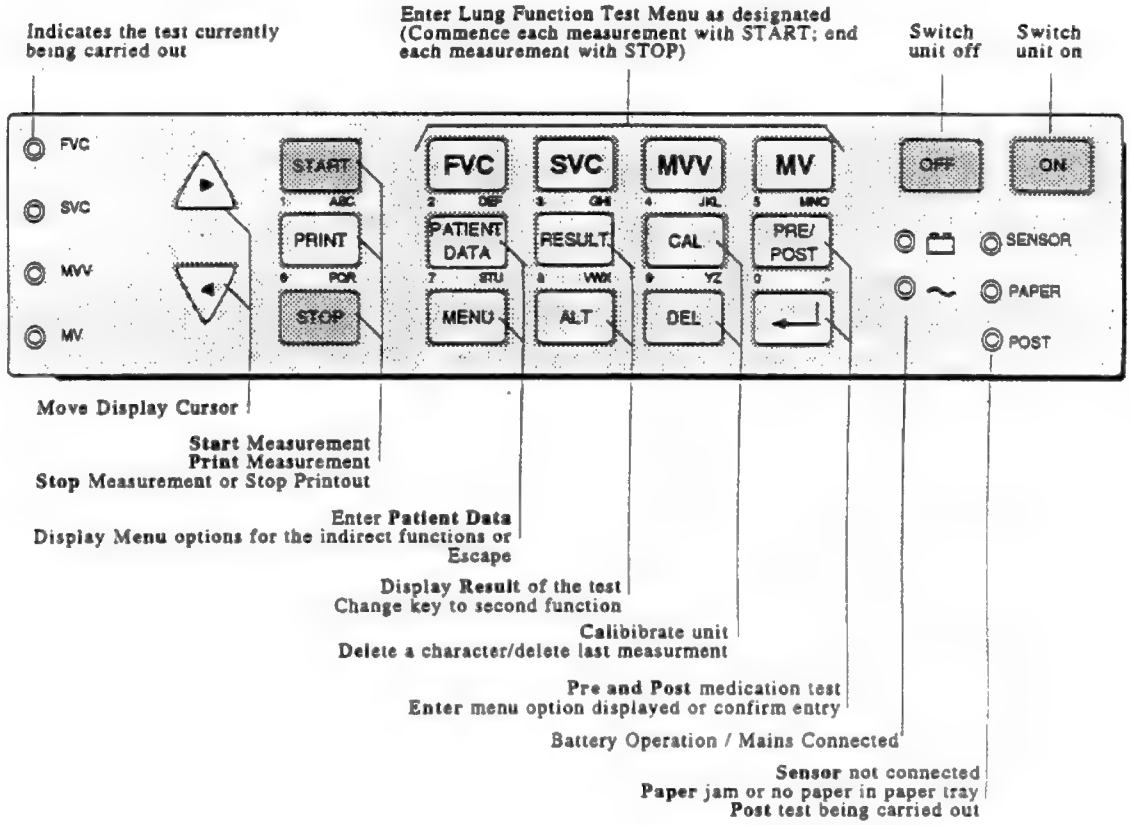
The unit can be operated from the mains or from the built-in rechargeable battery. The mains connection is on the rear of the unit. The mains indicator lamp is always lit when the unit is connected to the mains supply. A battery indicator lamp confirms battery operation. When the battery capacity is limited, the indicator flashes. To recharge the battery, connect the apparatus to the mains supply by means of the supplied power cable. A totally discharged battery needs less than 15 hours to be fully recharged (60% in less than 3 hours, 90% in 6 hours).

A fully charged battery lasts approximately 7 hours of normal use (SP-1R 6 hours). The unit can remain connected to the mains supply without any danger of damage to either the battery or the unit.

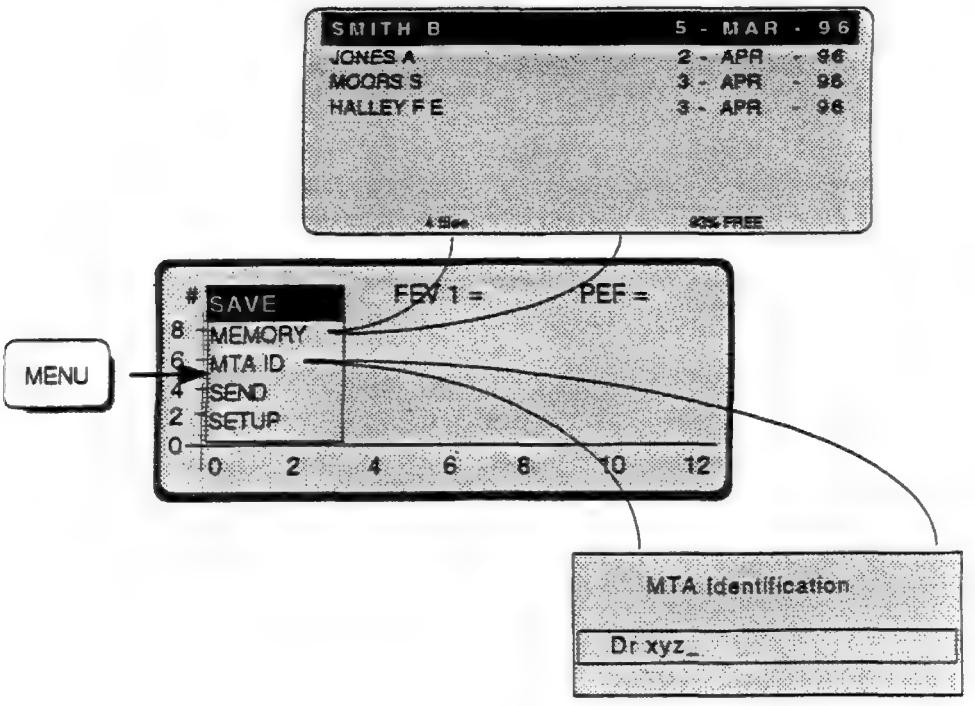
Switching On and Off

The SPIROVIT SP-1 is switched on and off with the ON and OFF keys.

Keyboard


Indicates the test currently being carried out
Enter Lung Function Test Menu as designated (Commence each measurement with START; end each measurement with STOP)
Switch unit off
Switch unit on
FVC
SVC
MVV
MV
START
PRINT
STOP
FVC
SVC
MVV
MV
PATIENT DATA
RESULT
CAL
PRE/ POST
MENU
ALT
DEL
OFF
ON
SENSOR
PAPER
POST
Move Display Cursor
Start Measurement
Print Measurement
Stop Measurement or Stop Printout
Enter Patient Data
Display Menu options for the indirect functions or Escape
Display Result of the test
Change key to second function
Calibibrate unit
Delete a character/delete last measurment
Pre and Post medication test
Enter menu option displayed or confirm entry
Battery Operation / Mains Connected
Sensor not connected
Paper jam or no paper in paper tray
Post test being carried out

Main Menu Overview



Main Menu

Memory	The SP-1 has a memory for up to 100 measurements. Select the memory menu item to: . Display a previously recorded patient . To delete a patient record
MTA Ident	Enter the name of the person carrying out the test. The MTA name (medical technical Assistant) is given on printouts. The users name entered here, is remembered when the unit is switched off; it only needs updating when a new user takes over. See below.
Send	When selected all recordings are sent automatically over the RS-232 interface (for example to the SEMA PC storage program). Note that the RS-232 protocol settings must be defined in the setup menu before transmission.
Setup	See System Setup Menu following

When a menu is displayed use these keys to move the cursor UP / DOWN. When an enter field is displayed e.g. MTA Ident, use these keys to move the cursor LEFT / RIGHT

When a menu is displayed - press this key to select highlighted menu option. When an enter field is displayed e.g. MTA Ident, use this key to confirm entry and to exit field

MENU — Use this key to display the main menu as above. When an enter field is displayed, this key is used the same as the ENTER key to confirm entry and to exit field

Setting Screen Contrast and Entering Data

Setting the Contrast

Change the contrast of the screen to your preference as follows:

Press the ALT key and the MENU key together then change the contrast with the cursor keys UP and DOWN

Entering data in a field

Printed below certain keys on the keyboard are letters. In a data field (e.g. MTA Ident) press the key once to enter the first character, twice to enter the second character, and three times to enter the third character.

The character is displayed on the screen as entered. Press the right cursor key to confirm the entry and move to the next character position.

Use the left and right cursor keys at any time to select a position to change that character.

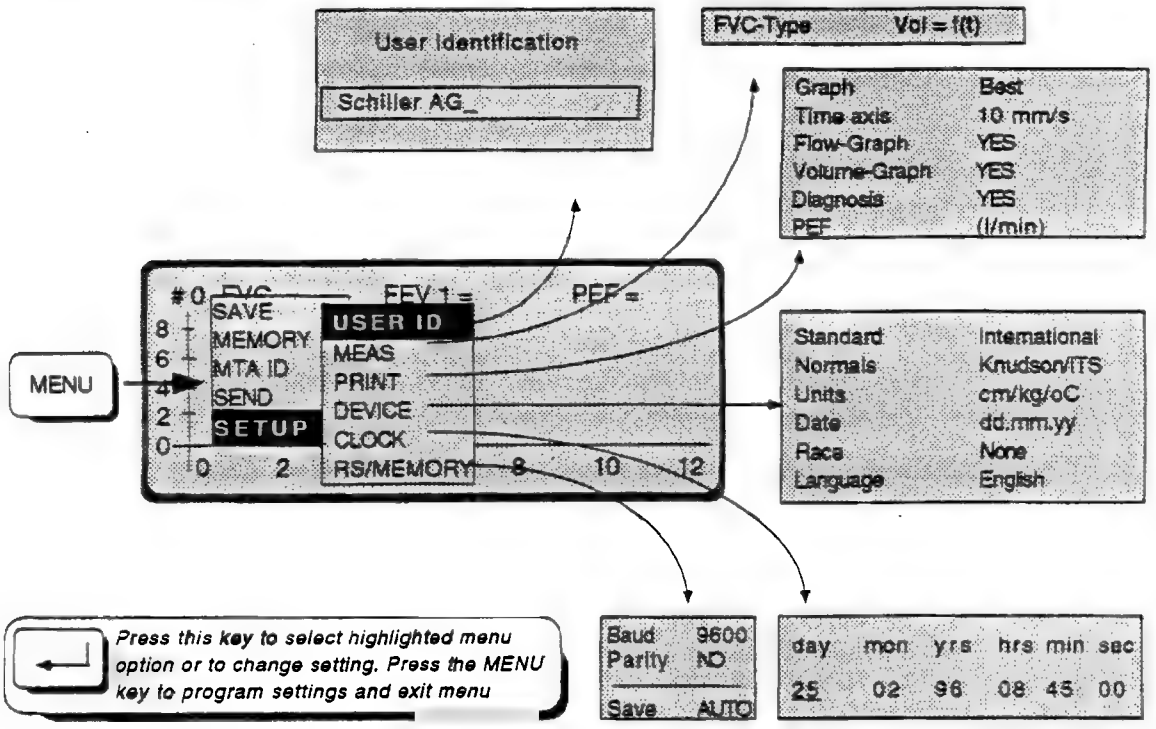
Press the ENTER key or the MENU key to confirm entry and exit the field.

When an entry field requires a numerical input e.g. date of birth, the number keys are automatically selected. When an entry field requires a letter input e.g. patient name, the letter keys are automatically selected. If a numerical input is required for example in the patient name, or conversely a letter input required in the date of birth, pressing the ALT key before the character/ number key enables this. Therefore when entering data:

ALT + key = number input in character field

ALT + key = character input in number field

System Setup Menu

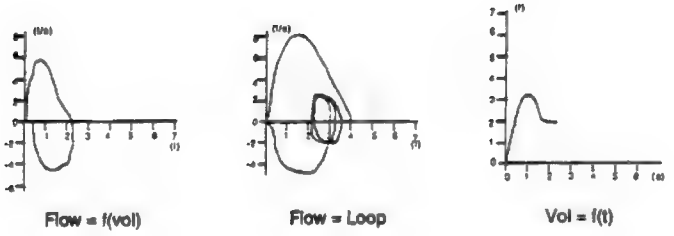


This menu option defines all the general settings. All entries remain stored (even when the unit is switched off) until overwritten. The settings are as follows:

User Ident — Use this to enter the name of the consultant or department that operates the unit.

Measurement — This is how the FVC graph is displayed and printed. With the ENTER key toggle the options to set a flow display of one of the following:

- Flow = f(vol)
- Flow = loop
- Vol =f(t)



System Setup Menu (cont.)

Print — This defines the format and content of the printout when the PRINT key is pressed. The settings are as follows:

Graph	Select ALL or BEST (measurements)
Time Axis	This defines the time axis of the graph - set to 10mm/s or 20mm/s
Flow graph	Set to ON or OFF - graph printed or not printed
Volume Graph	Print the volume graph - select YES or NO
Diagnosis	Diagnosis printed or not printed -select YES or NO
PEF	Peak Expiratory flow calculation - select litres/ min or litres/second

Device

STANDARD — Set to 'International' for all countries outside the USA and Canada or to 'American' for USA and Canada

NORMALS — The diagnosis is based on the standard defined here. The Normal value standards are given at the end of this section- 'Diagnosis and Norm Value Tables'

UNITS — Set to : cm / kg /°C, cm / kg /°F, inch / lb. /°F

DATE — Set the order of the date to month - day - year, day - month - year or year-month-day

RACE — NONE (no race); recommended for Europe,

W/B (White/ Black) for all countries outside the USA and Canada

C/H/B/A (Caucasian / Hispanic / Black / Asian) for USA and Canada

The standards and Norm Values are detailed at the end of this section (Diagnosis and Norm Values). The individual setting for race, and the effect of race on results is detailed in the Patient data (see following page)

LANGUAGE — This defines the language on the printout and menu structure. Set to English, German, French, Italian, Spanish, or Portuguese

Clock — Set the time and date

RS-232 — The Baud rate and parity setting (No/odd/even) can be stored.

The following table shows typical setup combinations.

Norm Values (Normals)	Spirometry Standard	Race	Units
ECCS / QUANJER	International	(W/B) or NONE	cm / kg / C
BERGLUND / QUANJER			
FINNISH / QUANJER			
INDIAN			
ÖSTERREICH			
KNUDSON / ITS	American	(C/H/B/A) or NONE	inch / lb / F
KNUDSON76 / ITS			
CRAPO / ITS			
MORRIS / ITS			
POLGAR / ITS			
COMPOSITE			

Pulmonary Function Test Procedure

The test method for the FVC, SVC, MVV and MV test is the same. Proceed as follows:

1. Calibrate the unit

THE UNIT MUST BE CALIBRATED

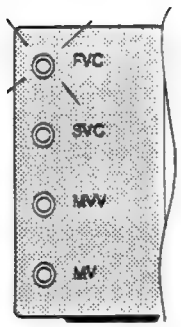
- At the beginning of each day
- If the sensor is changed
- When a significant temperature or pressure difference occurs

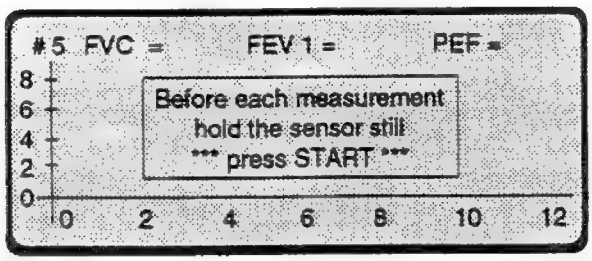
2. Press the function test key

- FVC
- SVC
- MVV
- MV

The relevant keyboard lamp lights and the corresponding coordinate presentation appears on the display as shown in this example for FVC

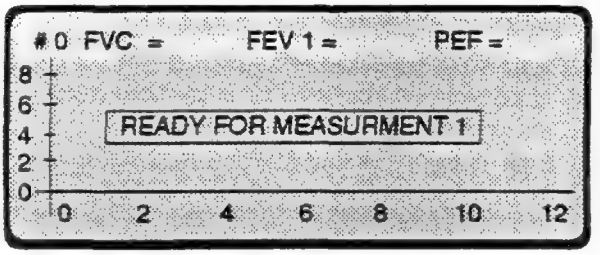
The coordinates represent the graph on which the curve will be drawn with the respiratory volume in litres being represented on the vertical axis and the time in seconds on the horizontal axis.





3. Press the START key

Pulmonary Function Test Procedure (cont.)



The flow sensor must be held quite still and no air should be breathed into the device for at least one second before and after the START key is pressed.

The message "READY FOR MEASUREMENT" appears on the display together with a volume counter graph for the value. As soon as the patient starts to breathe into the flow sensor, the unit begins to record the expiratory flow. The corresponding curve is represented on the display. The break-off point for the expiration measurement is reached automatically (or the Stop key is pressed).

4. Press the STOP key on completion of the test.

5. Repeat steps 3 and 4 until three measurements have been taken.

Note: If the Start key is again pressed (a fourth or more times), only the best three measurements are stored.

When American standards are stipulated, the message "ATS criteria met" appears on the printout if the deviation (as stipulated by the American Thorasic Society) between the best and second best measurements is not greater than 200ml or 5%.

Following a series of patient measurements the best two results are recorded and stored along with the last test made (which may or may not be one of the best three). These three results can then be printed graphical along with a table of the best individual measurements (from these three results). The table of the best measurements can also be displayed on the screen.

Definition of Best

In accordance with the ATS Spirometry Standard (11 November 1994), the best recordings are defined as the highest value from the calculation:

Best = FVC + FEV1

The measurement table (on the printout and on the display) gives the highest individual measurements (e.g. FVC, FEV1, SVC, MVV etc.) from the two best recordings as defined above, and the last recording made. This is true for all parameters except the following which are based solely on the highest FVC + FEV1 value:

- $FEF_{0.2-1.2}$
- $FEF_{25\%-75\%}$
- $FEF_{75\%-85\%}$
- $FEF_{25\%}$
- $FEF_{50\%}$
- $FEF_{75\%}$
- $FIF_{50\%}$

and when loop graph selected:

- ERV
- IRV
- TV

Pulmonary Function Test Procedure (cont.)

Displaying the Results in Tabular Form

Press the RESULT Key after a measurement, or series of measurements have been made. A measurement table is displayed for the test mode (as indicated by the test lamp) as follows:

FVC

	MEAS	PRED.	%PRED
FVC	4.82	4.31	112
FEV 1.0	4.52	3.50	129
FEV 1/FVC	9.36	8.23	114
FEF 2-1.2			
FEF 25-75%			
FEF 75-85%			

SVC

	MEAS	PRED.	%PRED
SVC	-.--	-.--	-.--
ERV	-.--	-.--	-.--
IRV	-.--	-.--	-.--
TV			

MV

	MEAS	PRED.	%PRED
MVV	-.--	-.--	-.--
RR	-.--	-.--	-.--
TV	-.--	-.--	-.--
MV	-.--	-.--	-.--
RR	-.--	-.--	-.--
TV	-.--	-.--	-.--

The display gives the measured values and the predicted values (calculated from the entered patient data). The predicted values can only be calculated when the patient data has been entered.

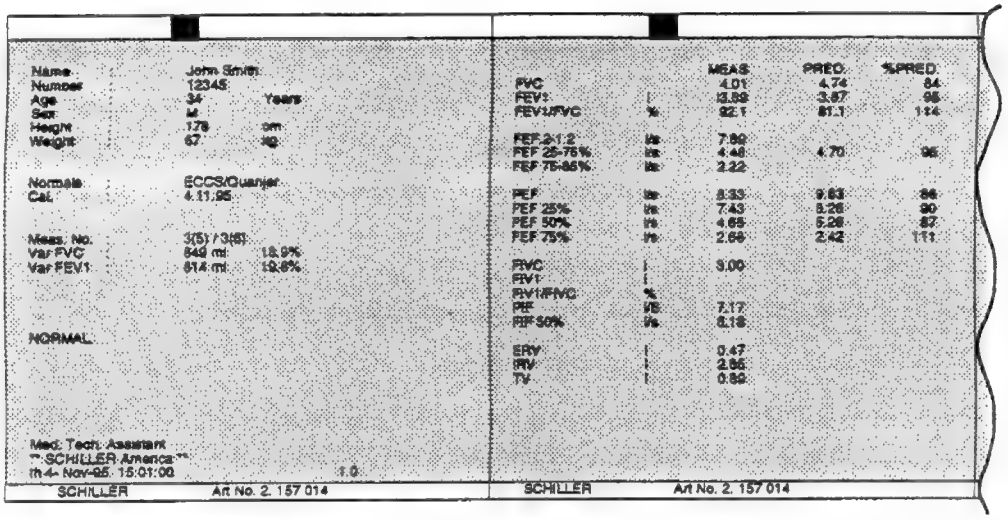
The result displayed is in accordance with ATS recommendations and is the best result *for each individual parameter*, from the three tests recorded.

When subsequent tests are made, the result with the highest value will always be saved and given in the measurement column. Press the MENU Key to return to the graphic display.

It can happen that the best FVC value is taken from Measurement 1 and the best FEV1 value is taken from Measurement 2.

Obtaining a Printout

Press PRINT after taking all measurements.



Name : John Smith
Number : 12345
Age : 34 Years
Sex : M
Height : 178 cm
Weight : 67 kg

Normals : ECCS/Quanjer
Cal. : 4.11.95

Meas. No. : 3(5) / 3(6)
Var FVC : 849 ml 18.9%
Var FEV1 : 814 ml 19.8%

NORMAL

Med. Tech. Assistant
SCHILLER America
th 4- Nov-95 15:01:00 1.0
SCHILLER Art No. 2. 157 014

		MEAS.	PRED.	%PRED.
FVC	l	4.01	4.74	84
FEV1	l	3.88	3.87	98
FEV1/FVC	%	92.1	81.1	114
FEF 0.1-1.2	l/s	7.80		
FEF 25-75%	l/s	4.48	4.70	96
FEF 75-85%	l/s	2.22		
PEF	l/s	8.33	9.63	86
FEF 25%	l/s	7.43	8.26	90
FEF 50%	l/s	4.65	5.28	87
FEF 75%	l/s	2.68	2.42	111
FIVC	l	3.00		
FIV1	l			
FIV1/FIVC	%			
PIF	l/s	7.17		
FIF 50%	l/s	6.18		
ERV	l	0.47		
IRV	l	2.66		
TV	l	0.82		

SCHILLER Art No. 2. 157 014

The following is given:

- The patient data
- The selected norm values
- The date of last calibration
- The number of tests stored. If more than three tests are made the figure given in brackets indicates the total number of tests carries out. The number of post tests stored, and the total number of post test made are given in the same manner after the slash. In the example given opposite, a total of 5 tests were carried out and a total of 6 post tests.
- The FVC and FEV1 variation in ml between the best and second best measurements. If this value is within 200ml or 5% the message 'ATS criteria met' is printed.
- The diagnostic statement (if enabled in Settings menu)
- The MTA identification
- The user identification
- The date and time of the printout
- The software version and the installed options (M = memory) are also indicated at the bottom of this page.

The second section of the printout comprises:

- the test results presented as a table giving the best values, the predicted values and the best values as a percentage of the predicted.
- the graph of the best test or the curves for all three tests depending on selection (see page 16).
- other curves and data dependent on test made

The Graphs of the measurements are given on the subsequent page(s). Note that the FIVC values and the ERV values are only given if Inspiration is taken with the FVC test and if Loop is selected in for measurement (see system setup menu).

Pulmonary Function Test Procedure (cont.)

Forced Vital Capacity (FVC) Test

For this test the patient must exhale as quickly as possible from the time of starting the test.

Note: The FVC test employs the "Back extrapolation" method. If the extrapolated volume is too large (>0.15 litres or 5% of FVC), then a warning appears on the display

To carry out the test for Forced Vital Capacity (FVC), press key "FVC" and the corresponding coordinate presentation appears on the display

The patient must exhale as quickly as possible from the time of starting the test so be sure that he understands what is required of him. If inspiratory measurements are required, the exhalation can be immediately followed by a maximum inhalation. The inspiration results will be given on the printout.

Before initiating a printout of the FVC Test, ensure that the settings are correct as detailed previously. Press the **PRINT** key to obtain a printout as defined.

Slow Vital Capacity (SVC) Test

The patient should breathe normally 3 times and then inhale maximally to total lung capacity and then exhale maximally. Make sure that the patient understands what is required of him.

MVV Test

The patient should breathe as deeply and as rapidly as possible over a period of 6 to 12 seconds so make sure that he understands what is required of him.

WARNING

EXTREME CARE SHOULD BE EXERCISED WHEN PERFORMING THIS TEST AS THERE IS A DANGER OF HYPERVENTILATION. ENSURE THAT THE PATIENT IS SITTING DOWN.

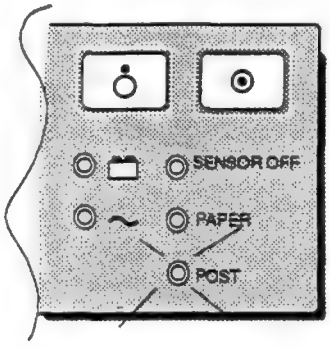
MV Test

The patient should breathe as normally as possible for up to 60 seconds, but for at least 20 seconds. Make sure that the patient understands what is required of him.

Pulmonary Function Test Procedure (cont.)

Post-Medication Tests

In order to carry out post-medication tests for comparison, press the PRE/POST key and "POST" Lamp lights



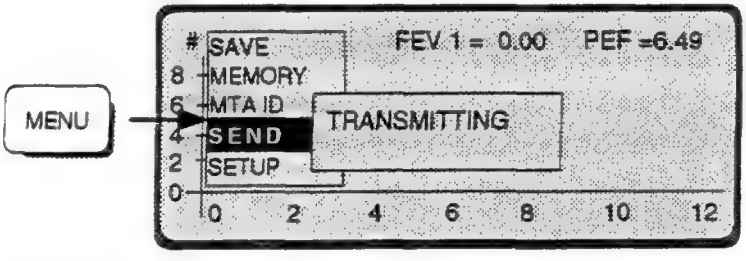
The post-medication tests are carried out in the same way as the premedication tests (three measurements stored). The printout following post-medication tests will give the curves of both pre and post-medication tests (the premedication curve is bold). The measurement results are shown as the best results (pre/post), results as a percentage of those predicted, (both pre and post) and the percentage change (i.e. difference) between pre and post-medication results.

The diagnosis resulting from the premedication test is also given on this printout.

Sending

Measurements can be sent to the SEMA data management system. Make sure that the communication parameters, ie baud rate, parity etc. are set the same on the transmitting and the receiving side. See Chapter 3 (RS-232 Check) for further details. To send a measurement proceed as follows:

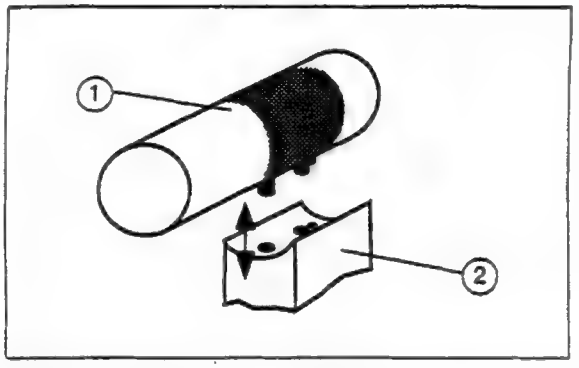
- Connect the PC to the RS-232 connector on the right hand side of the unit.
- Carry out the measurement(s) as described previously.
- Press the MENU key and select SEND



When the transmission is complete a message is displayed showing that successful transmission has been completed. If an error message is displayed e.g. 'serial link time-out' check settings in the PC and on the unit. Check the cable connection. Ensure that the Baud rate and the parity settings are the same in both the PC and the unit (SETUP menu).

Flow Sensors

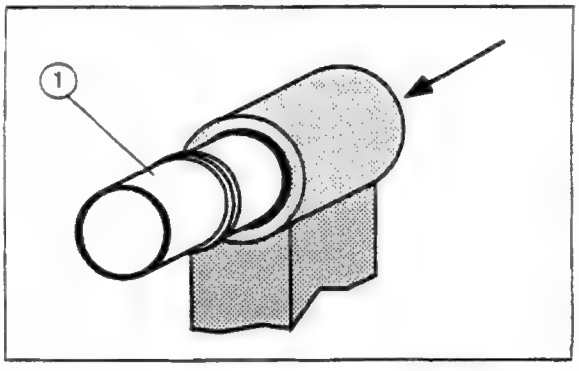
Flow Sensor SP-150

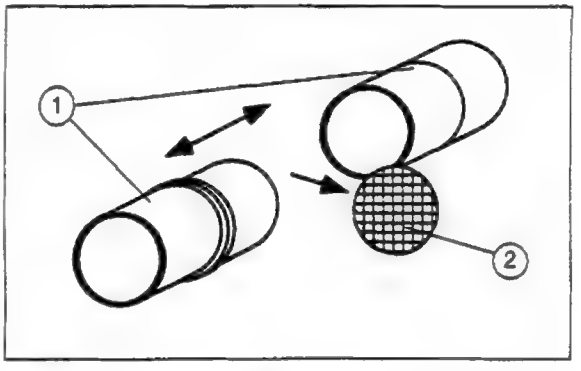


1. Remove disposable mouthpiece (1) by gently but firmly pulling it away from the handle (2).
2. Discard the complete assembly.
3. Position new disposable mouthpiece (**Part No. 2.100077**) and gently but firmly click it in position.

NOTE: The disposable mouthpiece can only be positioned in one direction and no force is necessary to insert it on the handle.

Flow Sensor SP-20





1. Slide out the combined filter/mouthpiece assembly (1). This is only possible in one direction.
2. Unscrew the assembly.
3. Remove and discard filter (2).
4. Clean and disinfect the assembly after every patient.
5. Insert a new filter (**Part No. 2.100123**).
6. Carefully screw the two halves of the assembly together again. *Make sure that the filter is not displaced.*
7. Push the combined filter/mouthpiece assembly gently but firmly into the outer tube until it makes contact on the outside edge of the outer tube. The assembly can only go in one direction.

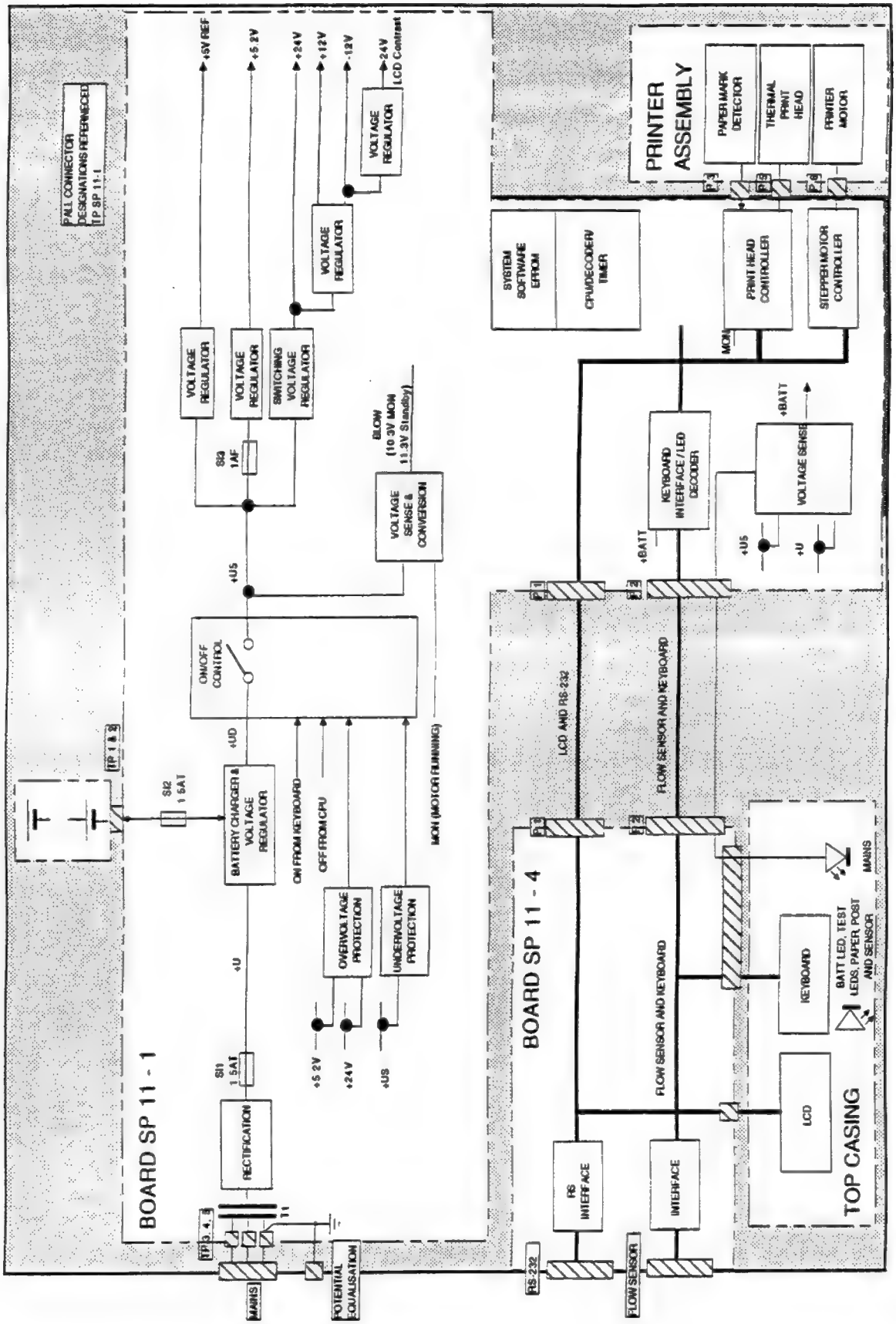
Chapter 2
Functional Overview

Contents

Introduction	***2.2***
SP 11 - 1	***2.4***
Power Supply	*2.4*
CPU and Processing Circuits	*2.4*
Memory	*2.4*
Thermal Print Head Controller	*2.5*
Paper Mark	*2.5*
Power On Reset	*2.5*
Stepper Motor Controller	*2.5*

Introduction

This Chapter provides a functional overview of the SP-1 electronics. The aim of this overview is to enable the service engineer to identify processing paths in order to help identify possible faulty modules. A functional block diagram supports the text.


BOARD SP 11 - 1
BOARD SP 11 - 4
TOP CASING
PRINTER ASSEMBLY
P.N.I. CONNECTOR DESIGNATIONS REFERENCED TO SP 11-1
+5V REF
+5.2V
+24V
+12V
-12V
LCD Contrast
VOLTAGE REGULATOR
SWITCHING VOLTAGE REGULATOR
SI3 1AF
SI2 1.6AT
SI1 1.5AT
BATTERY CHARGER & VOLTAGE REGULATOR
ON/OFF CONTROL
RECTIFICATION
OVERVOLTAGE PROTECTION
UNDERVOLTAGE PROTECTION
VOLTAGE SENSE & CONVERSION
BLOW (10.3V MON 11.3V Standby)
MON (MOTOR RUNNING)
ON FROM KEYBOARD
OFF FROM CPU
+US
+U
+UD
+5.2V
+24V
+US
SYSTEM SOFTWARE EPROM
CPU/DECODER/ TIMER
PRINT HEAD CONTROLLER
STEPPER MOTOR CONTROLLER
PAPER MARK DETECTOR
THERMAL PRINT HEAD
PRINTER MOTOR
KEYBOARD INTERFACE / LED DECODER
VOLTAGE SENSE
+BATT
LCD AND RS-232
FLOW SENSOR AND KEYBOARD
RS INTERFACE
INTERFACE
KEYBOARD
LCD
BATT LED, TEST LEDS, PAPER, POST AND SENSOR
MAINS
POTENTIAL EQUALISATION
RS-232
FLOW SENSOR

SP 11 - 1

Power Supply

The mains supply is full wave rectified to produce an unregulated dc supply (+U) of between approximately 15V and 28 V depending on mains voltage. This voltage is used by a switched voltage generator to produce +UD (13.5V). +UD charges the battery when mains is connected. When mains is not connected, +UD is the battery voltage.

An ON/OFF control logic switches +UD to three voltage regulators. The unit is switched on directly from the keyboard and then held on from the CPU (signal µPOFF). Detection of overvoltage on either the 5.2V or 24V supplies directly switches the unit off. Similarly when an undervoltage is detected on +US (indicating over current) the unit is directly switched off.

The mains LED is lit directly when mains is connected. The same circuit also monitors the switched dc supply (+US) and activates signal +BATT when the unit is switched on and mains is not connected (i.e. the unit is running on battery power).

A Battery low signal (BLOW) is generated when battery voltage (+US) falls to 11.3V. A circuit compensates for voltage drop when the printer stepper motor is active and the Blow signal is active only at 10.3V.

Note: The battery voltage is also monitored directly by the CPU which switches the unit off (µPOFF) when the voltage falls below approximately 9.4V.

CPU and Processing Circuits

Overall control and coordination of the SP-1 is by 68331CPU.

Memory

Program Memory

An EPROM contains the unit software. The EPROM has 128kByte of memory.

Static RAM Memory

The RAM memory stores the data and comprises two 128 kbyte RAM chips. The static RAM has battery backup for data retention when the unit is switched off.

Serial EEPROM

The serial EEPROM (U12) stores the unit base settings.

SP 11 - 1

Thermal Print Head Controller

The Thermal Print Head is controlled by a print head controller and timer circuit. The print head controller serialises the data for the print head and the timer circuit controls how long current is applied to the head, and thus the intensity of the printout.

Printer Timing

Strobe generation is triggered by signal TPS when one complete pixel line of data is ready to be written. The first output from 4-bit binary counters trigger a monostable multivibrator (U37) at a pulse length defined by the temperature and resistance of the print-head (TPHT). The pulse is passed through a decoder to set STROBE 1 signal.

Paper Mark

The Paper Mark signal from the printer is fed to a comparator. The paper mark detection voltage input to the comparator between approximately 2.5 V and 3.5V and when this is present the PMARK signal is logic 1.

Power On Reset

The Power on reset circuit controls the master reset of the CPU. This circuit has two functions as follows:

- To provide a delay on initial switch-on to ensure that the power supply is fully stabilized and give the 200ms reset time required by the processor.
- To disable the unit if the +5V rail drops below +4.75V.

Stepper Motor Controller

The printer stepper motor controller sets the speed of the printer motor with a clock frequency dictated by the master CPU.

The purpose of the stepper motor controller circuit is to ensure that the motor speed requested by the Microprocessor is achieved and maintained.

Paper Speed (motor speed)	**MCLOCK Frequency**
25mm/s	1.4kHz

Chapter 3
Fault Diagnosis

Contents

Introduction	*3.2*
Fault Diagnosis Chart	*3.3*
General Check Procedures	*3.4*
Calibration	*3.5*
Service Screen	*3.7*
LCD Check	*3.8*
EEPROM Check	*3.8*
RS-232 Check	*3.8*
Printer Check	*3.13*
Sensor Flow Check	*3.13*

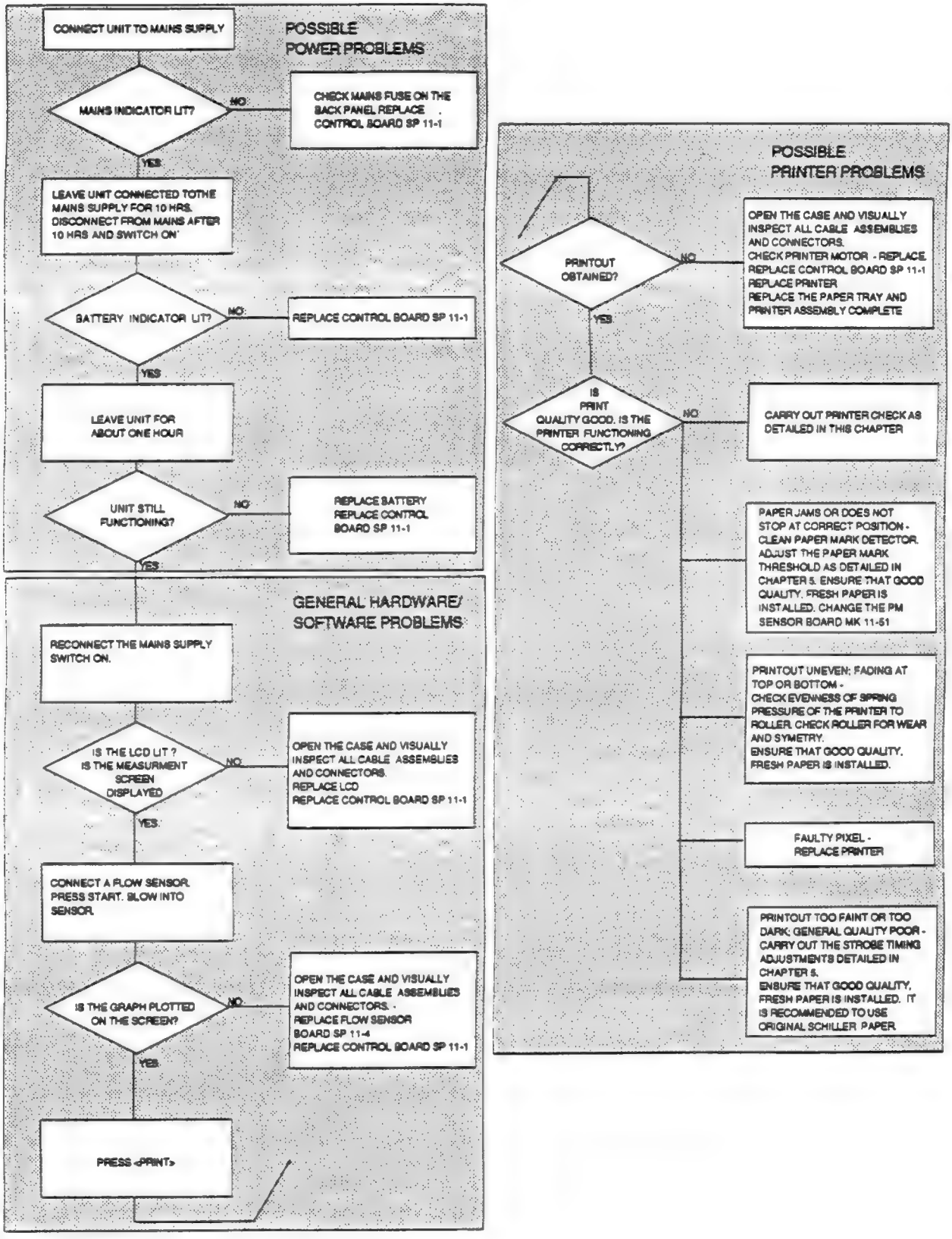
Introduction

The SP-1 is designed to be simple to use and simple to service: the service philosophy of the SP-1 is module replacement and not board repair. The purpose of this chapter is to provide fault-finding procedures that will quickly and efficiently identify a fault to a specific module. Fault-finding procedures are designed so that test equipment is kept to a minimum.

An initial fault diagnosis chart is provided detailing all the general fault indications. Use the fault finding charts and procedures on the following pages to indicate a faulty area or module. In most cases the fault finding charts should indicate the most likely faulty area. When more than one module is stated, the first module given is the one most likely to contain the fault. Other modules given should be checked in the order given. When a module has been replaced specific test parameters and setting-up of the module may be applicable. The removal and replacement instructions for all replaceable modules, along with any setup or check procedures required, are given in Chapters 4 and 5.

If the initial fault-finding chart does not indicate the area where the fault exists, re-check all the settings and parameters that have been entered. If these are correct, check the software.

Fault Diagnosis Chart


CONNECT UNIT TO MAINS SUPPLY
POSSIBLE POWER PROBLEMS
MAINS INDICATOR LIT?
NO
CHECK MAINS FUSE ON THE BACK PANEL REPLACE . CONTROL BOARD SP 11-1
YES
LEAVE UNIT CONNECTED TOTHE MAINS SUPPLY FOR 10 HRS. DISCONNECT FROM MAINS AFTER 10 HRS AND SWITCH ON'
BATTERY INDICATOR LIT?
NO
REPLACE CONTROL BOARD SP 11-1
YES
LEAVE UNIT FOR ABOUT ONE HOUR
UNIT STILL FUNCTIONING?
NO
REPLACE BATTERY REPLACE CONTROL BOARD SP 11-1
YES
GENERAL HARDWARE/ SOFTWARE PROBLEMS
RECONNECT THE MAINS SUPPLY SWITCH ON.
IS THE LCD LIT ? IS THE MEASURMENT SCREEN DISPLAYED
NO
OPEN THE CASE AND VISUALLY INSPECT ALL CABLE ASSEMBLIES AND CONNECTORS.
REPLACE LCD
REPLACE CONTROL BOARD SP 11-1
YES
CONNECT A FLOW SENSOR. PRESS START. BLOW INTO SENSOR.
IS THE GRAPH PLOTTED ON THE SCREEN?
NO
OPEN THE CASE AND VISUALLY INSPECT ALL CABLE ASSEMBLIES AND CONNECTORS. -
REPLACE FLOW SENSOR BOARD SP 11-4
REPLACE CONTROL BOARD SP 11-1
YES
PRESS <PRINT>
POSSIBLE PRINTER PROBLEMS
PRINTOUT OBTAINED?
NO
OPEN THE CASE AND VISUALLY INSPECT ALL CABLE ASSEMBLIES AND CONNECTORS.
CHECK PRINTER MOTOR - REPLACE.
REPLACE CONTROL BOARD SP 11-1
REPLACE PRINTER
REPLACE THE PAPER TRAY AND PRINTER ASSEMBLY COMPLETE
YES
IS PRINT QUALITY GOOD. IS THE PRINTER FUNCTIONING CORRECTLY?
NO
CARRY OUT PRINTER CHECK AS DETAILED IN THIS CHAPTER
PAPER JAMS OR DOES NOT STOP AT CORRECT POSITION - CLEAN PAPER MARK DETECTOR. ADJUST THE PAPER MARK THRESHOLD AS DETAILED IN CHAPTER 5. ENSURE THAT GOOD QUALITY. FRESH PAPER IS INSTALLED. CHANGE THE PM SENSOR BOARD MK 11-51
PRINTOUT UNEVEN; FADING AT TOP OR BOTTOM - CHECK EVENNESS OF SPRING PRESSURE OF THE PRINTER TO ROLLER. CHECK ROLLER FOR WEAR AND SYMETRY. ENSURE THAT GOOD QUALITY. FRESH PAPER IS INSTALLED.
FAULTY PIXEL - REPLACE PRINTER
PRINTOUT TOO FAINT OR TOO DARK; GENERAL QUALITY POOR - CARRY OUT THE STROBE TIMING ADJUSTMENTS DETAILED IN CHAPTER 5. ENSURE THAT GOOD QUALITY, FRESH PAPER IS INSTALLED. IT IS RECOMMENDED TO USE ORIGINAL SCHILLER PAPER

General Check Procedures

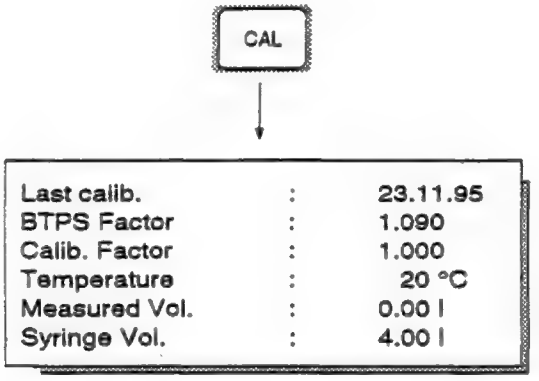
The procedure detailed here is a general confidence check in the unit after an internal module or board has been replaced. It is not a full functional test (which can only be carried out with dedicated equipment in the factory) but is intended to provide a general confidence check in all the major SP-1 functional areas. The instructions given here are guides to the basic functions. If more operating information is required (general settings, comprehensive menu guides etc.) please refer to the relevant User Manual for the software version applicable.

To carry out the general SP-1 functional check procedure, proceed as follows:

1. Connect mains power to the unit and ensure that the green mains LED lights.
2. Switch the unit on by pressing the <ON> key on the keyboard. Ensure that the LCD lights and the welcome screen is displayed.
3. Carry out the Printer Check detailed in this chapter
4. Connect flow sensor to the sensor connector on the side panel and switch on.
5. Carry out calibration procedure as detailed in this chapter
6 Carry out the EEPROM check detailed in this chapter
7. Switch the unit off and leave connected to the mains supply for 10 hours or more to charge the battery.
8. Disconnect the mains and switch the unit on. Ensure that the Battery LED is lit. Run the unit on battery power for approximately an hour. Ensure that the battery LED flashes when the battery has limited capacity (not before 45 minutes).

Calibration

To calibrate, proceed as follows:



IMPORTANT

THE UNIT MUST BE CALIBRATED WITH THE FIRST PULMONARY FUNCTION TEST OF THE DAY, AFTER EVERY SIGNIFICANT TEMPERATURE CHANGE OR AFTER CHANGING THE SENSOR.

Last Calibration date of last calibration

BTPS Factory calculated BTPS (=> Body Temperature, Ambient Pressure, Saturated with water vapour) value. This value compensates for the difference in inhaled and exhaled humidity. The unit is set for measuring exhaled volume (100% humidity, Temp 36.8°), and so when inhaled volume is measured this factor is applied. The SP-1 uses ambient temperature to calculate the BTPS factor. This is sufficient for accurate FIVC calculation. The formula used is as follow:

$$BTPS = 0.033 + \frac{273.15 + 36.8}{273.15 + Tu}$$

Tu is ambient temperature degrees centigrade
0.033 is equivialent to 760mmHg at 22 degrees C
273.15 is degrees absolute

Calibration Factor calculated value between measured and effective calibration air volume

Temperature ambient temperature in °C (or °F) dependent on device setting

Measured Volume air volume measured by the system from the calibration pump

Syringe Volume entered air volume depending on the size of the calibration pump and times the air was pumped through the sensor; e.g. pumping 2 litres 3 times amounts to 6 litres (the recommended volume with a 2 litre pump is 4 litres; with 3 litre pump, 6 litres)

Calibration (cont.)

Calibration Procedure

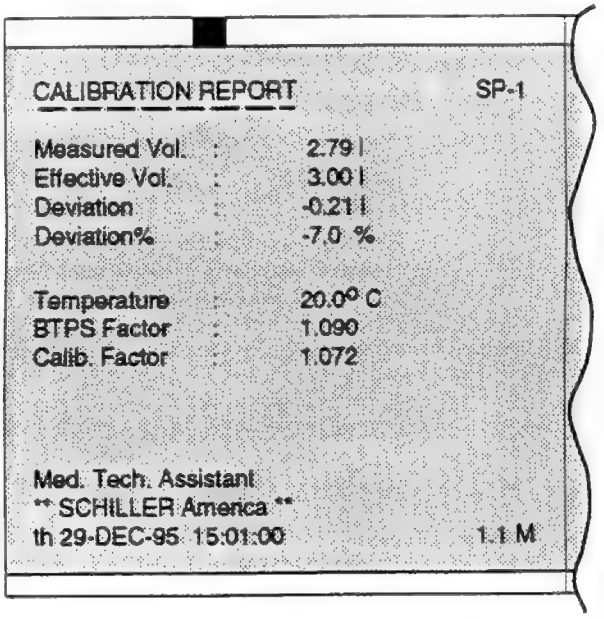
To calibrate the unit proceed as follows:

- Connect the calibration pump to the sensor. Ensure that there are no air leaks
- Press the CAL key - the menu is displayed as shown on the previous page
- The cursor is positioned at temperature. Enter the ambient temperature
- Press ENTER when the correct temperature entered
- Wait 1 second.
- Press the START key
- Pump 4 to 6 litres of air through the sensor

Note: Make sure that the flow sensor is kept still during the pumping operation.

While pumping, the unit records the volume being pumped through the flow sensor and indicates it on the display.

- Press the STOP key when finished pumping.
- Enter the pumped air volume at syringe volume prompt (depending on the size of the calibration pump and times of pumping; i.e. a 2 litre pump pumped 3 times = 6 litres).
- Press ENTER.
- The message "Calibration completed" appears on the display, press the PRINT key to obtain a printout of the calibration report with the following information:


CALIBRATION REPORT SP-1
Measured Vol. : 2.79 l
Effective Vol. : 3.00 l
Deviation : -0.21 l
Deviation% : -7.0 %
Temperature : 20.0° C
BTPS Factor : 1.090
Calib. Factor : 1.072
Med. Tech. Assistant
** SCHILLER America **
th 29-DEC-95 15:01:00 1.1 M

If the message 'EXCESSIVE DEVIATION! 'appears on the screen after a calibration, it indicates that the difference between the measured volume and the entered volume is too big (>25%). Check the temperature setting, the syringe volume and the entered syringe volume. If these are all correct change the screen/filter and recalibrate

Service Screen

To check the printer and to ensure that every pixel is operational, a built-in printer test is provided.
To carry out the printer check press:

MENU key then select <SETUP> <DEVICE>

then press the following keys simultaneously, in the order given:

ALT - MENU -PRE/POST

The following Menu options are given:

LCD

EEPROM

RS-232

PRINTER

SENSOR

These are explained on the following pages

Service Screen (cont.)

LCD Check

- Select LCD from the service menu (page 7)
- All characters are displayed. Select more characters with the up and down arrow keys. All screen pixels can be checked this way
- Press any key. The designation written on the key is displayed on the right hand side of the screen. All keys can be checked in this way.
- Return to the service menu by pressing the MENU key

EEPROM Check

- Select EEPROM from the service manu (page 7)
- The message `EEPROM Working` is displayed.
- On successful completion of the test the message `EEPROM okay` is displayed
- Return to the service menu by pressing the MENU key

RS-232 Check

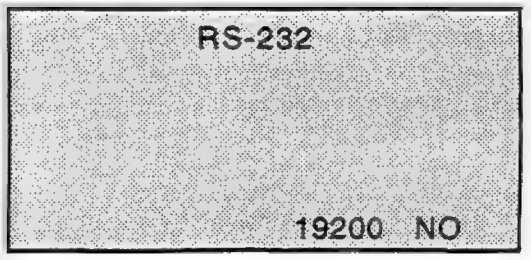
The following error messages are associated with the RS Interface. If any of these error messages are displayed, carry out the checks suggested.

SERIAL LINK TIME-OUT	This indication appears if no signal is received from the remote unit (after approximately 30 seconds). ◊ Check that the remote unit is switched on and set to the correct parameters ◊ Check the correct setup in both units ◊ Check that the connecting cable is correctly plugged in ◊ Check the integrity of the cable assemblies (at both units) ◊ If using a modem ensure that it is communicating with the remote modem
TRANSMISSION ERROR	This is a general fault indication ◊ Check that the remote unit is switched on and set to the correct parameters ◊ Check that the connecting cable is correctly plugged in ◊ Check the integrity of the cable assemblies (at both units) ◊ If using a modem, ensure that it is communicating with the remote modem
NO DATA	A transmission has been attempted, but no data is stored in the units´ memory. Store a measurement in the memory and attempt the transmission again. If the same message appears, change the processor board.

Service Screen (cont.)

RS-232 Check

When RS-232 is selected, the screen shows the Baud rate and the parity. The Baud rate can be changed by pressing the START key and the parity by pressing the PRINT key.



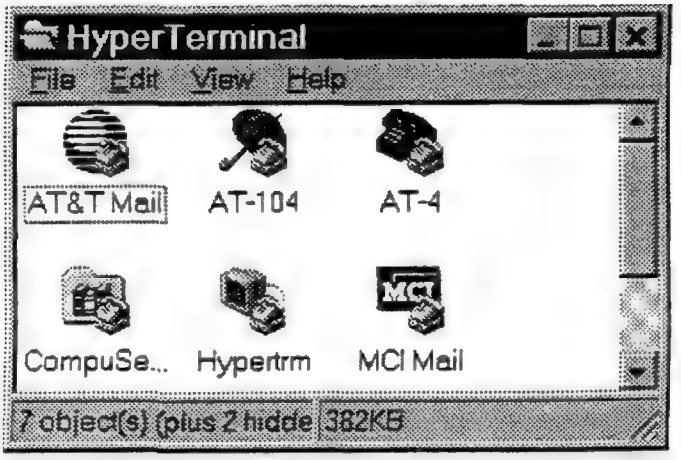
The test transmission / test reception options enables a test sequence to be generated and received. Use these test options to ensure that the receiving and transmitting units can communicate and that the cable assemblies, connectors etc. between the communicating units are good.

The test message generated is a string of all ASCII characters - ABCD.... 1234....abcd... etc. When the test transmission / reception option is selected, the string of characters sent by the transmitting unit are displayed on the LCD in the receiving unit. In the transmitting unit a message is displayed indicating that a test transmission is in progress.

To perform these tests, you will need a second SP-1 unit, or the SP-1 RS-232 interface has to be connected to an active terminal, for example the Hyperterminal, which is available under Windows 95™. The following equipment is needed:

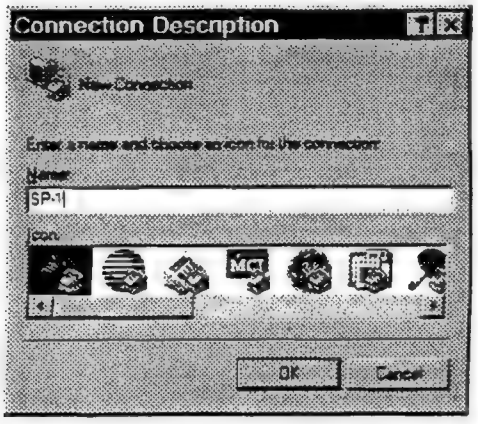
- A personal computer (PC) with Windows 95™ Hyperterminal installed.
- An RS-232 cable assembly, Art. No. 2. 310 159, for connecting the RS-232 interface on the SP-1 with the COM port of the PC. This assembly consists of a cable, Art. No. 2. 310 094 and an adapter DB 9 / DB 25, Art. No. 2. 100 552.

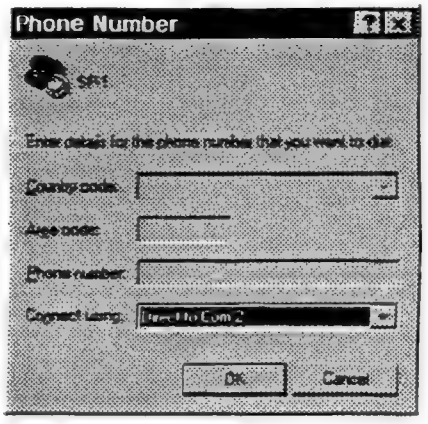
1. Start from Windows 95 desktop. Click on START. Select Programs / Accessories / Hyperterminal.



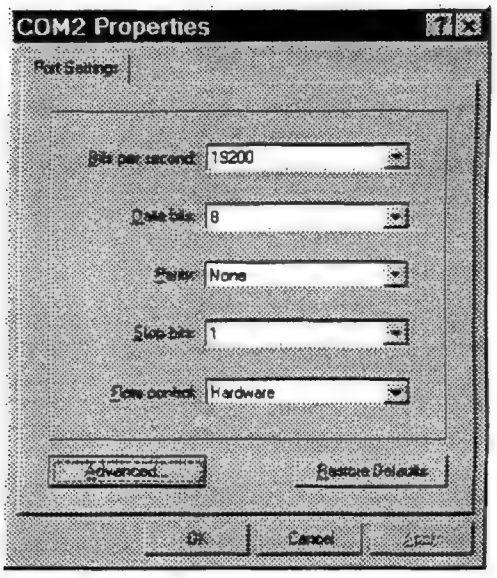
2. Double-click on Hypertrm(.exe). Enter the name SP-1 for the new connection and click on OK.

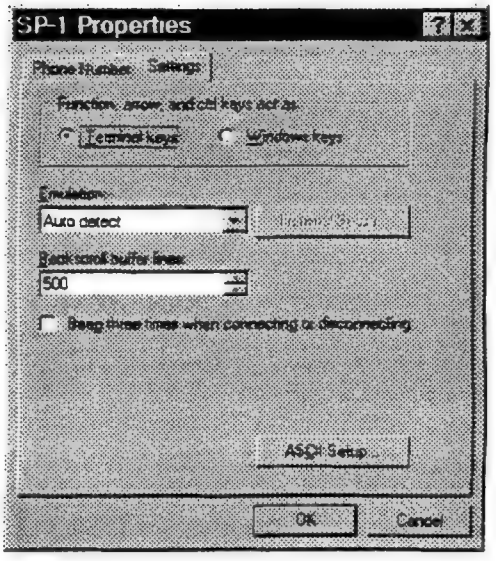
Service Screen (cont.)





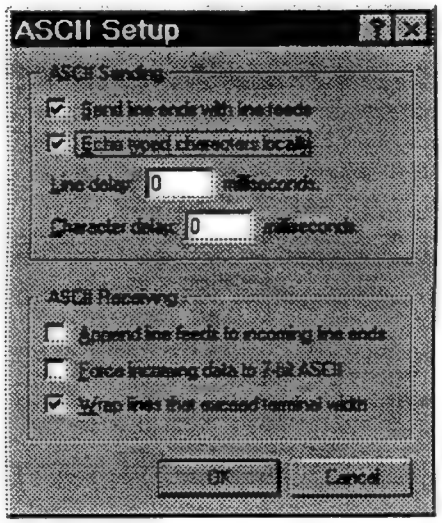
3. Set the direct connection to the proper COM-port and click OK.
4. Enter the port settings 19200, 8, N, 1, Hardware and confirm with OK..





5. You are now in the SP-1 Hyperterminal window. Click on File and select Properties.
6. Go to tab Settings and set Terminal keys, Auto detect and 500 buffer lines.
7. Click on ASCII Setup.

Service Screen (cont.)

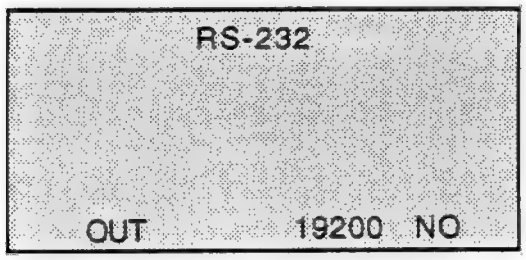


8. Check the boxes for "Send line ends with line feeds", "Echo typed characters locally" and "Wrap lines that exceed terminal width". Confirm with OK. Click once more on OK to get back to the open Hyperterminal window.

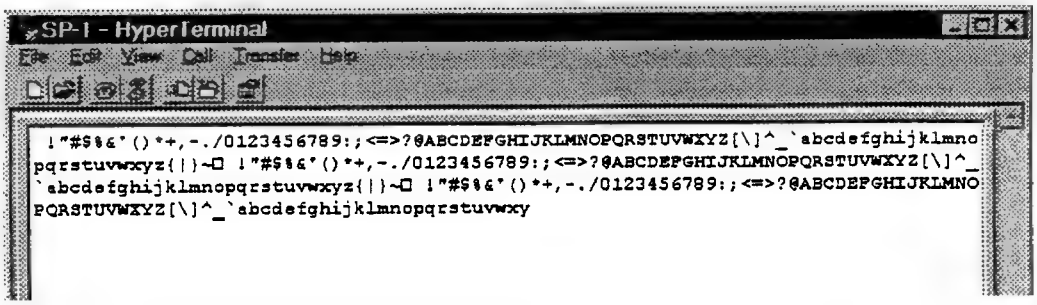
You are now ready to start the input and output tests.

Test Output

- On the SP-1, select the RS-232 screen, and make sure that the settings are 19200 bps, parity N, stopbit 1.
- Press the UP key



- The SP-1 now sends a string of alphanumerical characters, which are echoed in the Hyperterminal window on the PC.



- Stop the test by pressing the STOP key.

Service Screen (cont.)

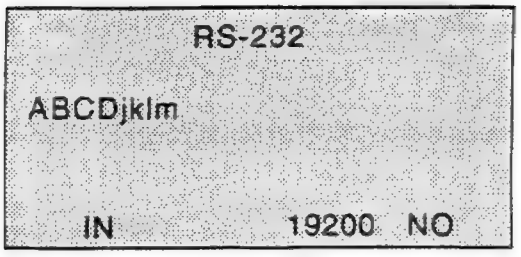
Test Input

For this test a SCHILLER RS-232 test plug is needed. If such a plug is not available, it can easily be fabricated from a standard 9-pin D-type plug.

The following pins must be wired:

- pins 2 and 3 (receive / transmit)
- pins 7 and 8 (RTS / CTS)
- pins 6 and 4 (DSR / DTR (ready))

1. Connect the RS test plug to the RS port on the SP-1.
2. Select the RS-232 test window.
3. Press consecutively the UP and DOWN keys to toggle between in- and output and confirm that some characters are echoed on the screen



4. Leave the RS-232 test window by pressing the MENU key twice.

Service Screen (cont.)

Printer Check

- Select PRINTER from the service manu (page 7)
- Various printer data is given. Ensure that the temperature reading is ambient ± 5 degrees.
- Press the PRINT Key (when still in the Printer service screen) - a test printout is given.
- Return to the service menu by pressing the MENU key

Carefully examine the printout and ensure that all the lines are even and uninterrupted. Any faulty print-head pixels will be seen as a horizontal white line. Examine the printout for evenness of print.

If a faulty pixel is detected the printer must be replaced. If the printout is uneven (for example darker at the top than at the bottom), it indicates that the printer alignment is not correct. If the printout is too faint or too dark, check the strobe adjustment. Also check the paper; old paper, paper that has been exposed to light for a long period, or poor quality paper can all adversely effect the print quality.

IMPORTANT: THE 'SHELF LIFE' OF THE PRINTER PAPER IS NOT INDEFINITE. OLD PAPER, PAPER THAT HAS NOT BEEN STORED IN A COOL DAMP FREE ENVIRONMENT, OR PAPER THAT HAS BEEN EXPOSED TO EXCESSIVE HEAT CAN ADVERSELY EFFECT THE QUALITY OF THE PRINT. IT IS RECOMMENDED TO USE ORIGINAL SCHILLER PAPER.

Print Head Alignment and Print Head Tension

The print head tension (the pressure that the print head exerts on the printer paper) is achieved with two spring exerting pressure on the print head: the print head tension cannot be adjusted. Similarly print head alignment is fixed and cannot be adjusted. If the print head tension or print head alignment is not correct change the paper tray and printer assembly.

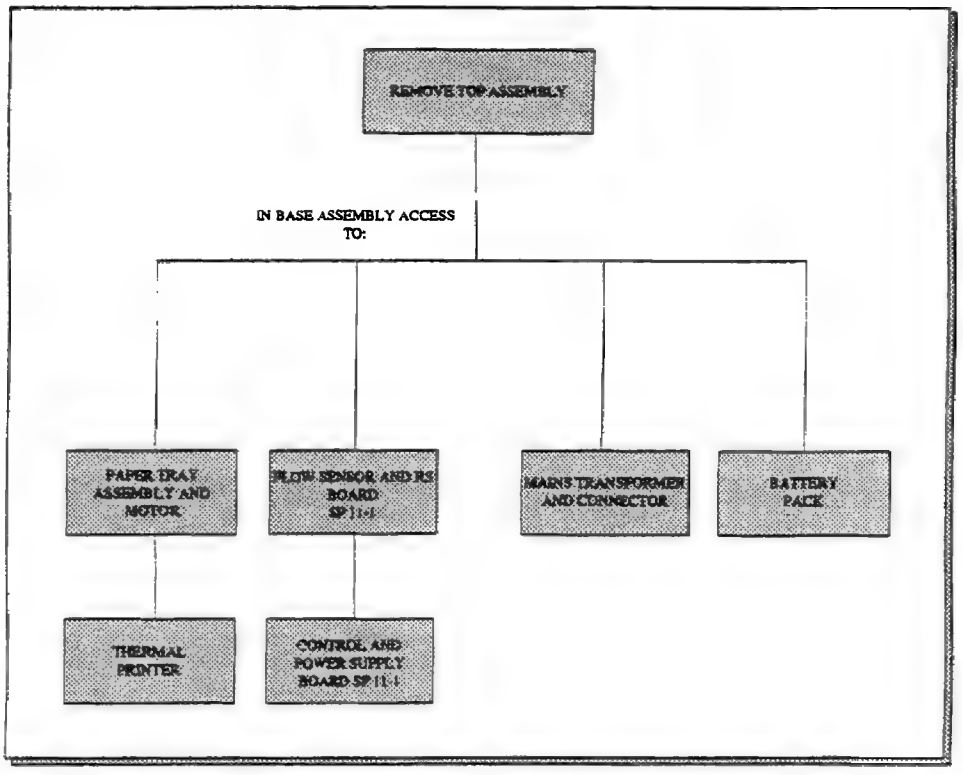
Sensor Flow Check

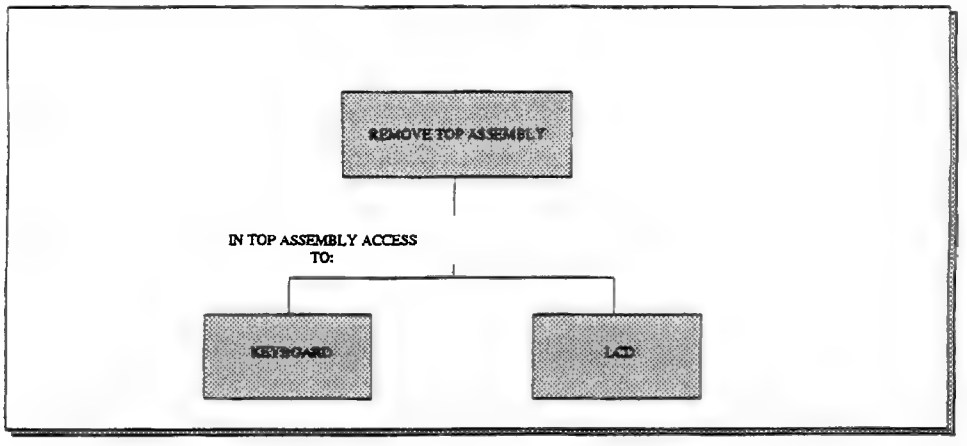
- Select SENSOR from the service manu (page 7)
- The Analog /digital value is given. Ensure that the value is 2042 ± 10
- Return to the service menu by pressing the MENU key.

Chapter 4
Module Removal and Replacement

Contents

Introduction	*4.3*
Safety Notices	*4.4*
Physical Overview	*4.5*
Test Equipment, Tools, and Accessories	*4.6*
Opening the Case	*4.7*
Top Assembly Removal	*4.7*
Top Assembly Replacement	*4.8*
Flow Sensor / RS Interface SP 11-4	*4.9*
Board Removal	*4.9*
Board Replacement	*4.9*
Checks and Tests after Replacement	*4.9*
Battery Pack	*4.10*
Battery Pack Removal	*4.10*
Battery Pack Replacement	*4.10*
Checks and Tests After Battery Replacement	*4.10*
Printer Tray Assembly and Thermal printer	*4.11*
Printer/Paper tray Assembly Removal	*4.12*
Thermal Printer Removal	*4.12*
Thermal Printer Replacement.	*4.12*
Printer/Paper tray Assembly Replacement	*4.12*
Checks, Tests and Adjustments after Printer Replacement	*4.12*
Control and Power Supply board SP 11-1	*4.13*
Board Removal	*4.13*
Board Replacement	*4.14*
Keyboard	*4.15*


REMOVE TOP ASSEMBLY
IN BASE ASSEMBLY ACCESS TO:
PAPER TRAY ASSEMBLY AND MOTOR
FLOW SENSOR AND RS BOARD SP 11-1
MAINS TRANSFORMER AND CONNECTOR
BATTERY PACK
THERMAL PRINTER
CONTROL AND POWER SUPPLY BOARD SP 11-1



Note: The Program EPROM is mounted on the Control and Power Supply board SP 11-1.

Introduction

This Chapter provides an overview of the procedures to remove and replace the modules that are spared at service level. The instructions given in this chapter are autonomous, with each module containing the following:

- The prerequisites that must be fulfilled before removing of the module
- Tools and equipment that are required to remove and replace the module and to carry out the functional checks and adjustments
- Removal Procedures
- Replacement Procedures
- Checks and Tests that must be carried out after replacement.

Any adjustments, jumper settings, special checks or functional procedures that are required during a procedure, are detailed in the relevant step.

In-text diagrams support the text where required and provide location details of connectors, test points and adjustment potentiometers.

Specific warnings and cautions are given where applicable. Warnings indicate potential danger that could cause personal injury. Cautions indicate areas that could cause damage to the equipment .

If a key operation or menu selection is required, the key sequence required is given in parenthesis '<>'. The character (or character string) given in parenthesis is the actual character that is printed on the key. When a key sequence is provided it must be followed in the order given.

Safety Notices

WARNINGS

BEFORE COMMENCING ANY REMOVAL OR REPLACEMENT PROCEDURES ENSURE THAT THE MAINS POWER SUPPLY IS SWITCHED OFF AND THAT THE MAINS CABLE IS REMOVED.

CERTAIN CHECKS AND ADJUSTMENTS CAN ONLY BE CARRIED OUT WITH THE TOP ASSEMBLY REMOVED AND WITH MAINS CONNECTED. WHEN CARRYING OUT THESE PROCEDURES BEWARE THAT POTENTIALLY LETHAL VOLTAGES ARE PRESENT.

CAUTIONS

THE SP-1 CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTISTATIC PRECAUTIONS:

◊ WHEN CARRYING OUT ANY MAINTENANCE PROCEDURES ALWAYS PLACE THE UNIT ON AN EARTHED ANTISTATIC MAT.

◊ PERSONNEL MUST BE EARTHED WHEN HANDLING ANY BOARDS OR COMPONENTS

◊ ALWAYS USE AN ANTISTATIC BAG WHEN TRANSPORTING BOARDS OR COMPONENTS

THE UNIT IS SUSCEPTIBLE TO ABRASION DAMAGE. TO PREVENT SCRATCHING, ALWAYS PLACE THE UNIT ON A SOFT, NON-ABRASIVE CLOTH WHEN CARRYING OUT MAINTENANCE PROCEDURES.

TAKE CARE NOT TO PLACE ANY STRAIN ON THE CONNECTING RIBBON CABLE WHEN REMOVING THE TOP ASSEMBLY . ENSURE THAT THE CABLE ASSEMBLY IS NOT CRIMPED OR TWISTED AND THAT THE TOP ASSEMBLY IS NOT PLACED ON THE CABLE ASSEMBLY.

CARE MUST BE TAKEN WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

THE PROCEDURAL STEPS GIVEN FOR EACH MODULE MUST BE FOLLOWED IN THE ORDER GIVEN.

Physical Overview

The SP-1 unit is enclosed in a two part, medical standard, moulded plastic case.

The top part contains the keyboard with the base section containing all the electronics of the unit, the thermal printer, the paper tray, the battery and mains transformer.

The electronics of the unit are contained on two printed circuit board (control and power supply board SP 11-1 and Flow sensor and RS board SP 11-4). The PCBs are secured on spacers moulded in the base section.

The battery is secured in position with double sided tape and the mains transformer is secured on spacers.

The thermal printer is mounted on a paper tray/thermal printer assembly which is secured in the base section complete.

Because of the plastic construction of the case, threaded metal inserts are used throughout for all screw fixings.

Test Equipment, Tools, and Accessories

The following list details the tools, test equipment and accessories required to carry out all functional tests, calibration procedures and adjustments that can be carried out on the SP-1. The test equipment given here is general. If specific recommendation for test equipment is required, please contact the SCHILLER service department.

- Digital Voltmeter
- Oscilloscope
- Frequency Counter
- Selection of cross-bladed, posi-drive and flat-bladed screwdrivers
- Cleaning agent such as Tricoetholine
- Selection of spanners
- Double-sided tape

Opening the Case

Prerequisites

- The unit must be placed on an antistatic mat and antistatic precautions observed when any maintenance is carried out on the SP-1. The room temperature should be between 18 and 28 degrees.
- THE WARNINGS AND CAUTIONS AT THE BEGINNING OF THE CHAPTER MUST BE OBSERVED.

Tools

- Posi-drive screwdriver

Test Equipment

The following test equipment is required to carry out the functional test after unit assembly

- flow sensor
- calibration pump

Top Assembly Removal

The Top Assembly is mounted on the Base Assembly and is secured to the Base Assembly with six screws; access to the screws is gained from the underside of the unit. To remove the Top Assembly, proceed as follows

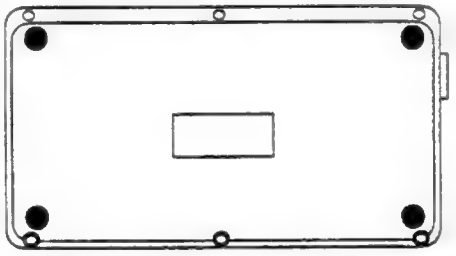
---

WARNING:

ENSURE THAT THE MAINS CABLE IS REMOVED.

---

1. Turn the unit upsidedown and rest on a soft antistatic cloth.



2. Unscrew and remove the six countersunk retaining screws and washers situated in the extreme corners and edges of the unit.
4. Grasping the top and bottom of the unit to ensure that the two assemblies cannot part, carefully return the unit to the standing position.
5. Gently lift the Top Assembly sufficiently to gain access to the interconnecting cables, and disconnect the cable assemblies between the flow sensor board SP 11-4 and the keyboard, and between the flow sensor board SP 11-4 and the LCD.
6. Gently lift the Top Assembly away from the Base Assembly and place on a soft cloth.

Opening the Case (cont.)

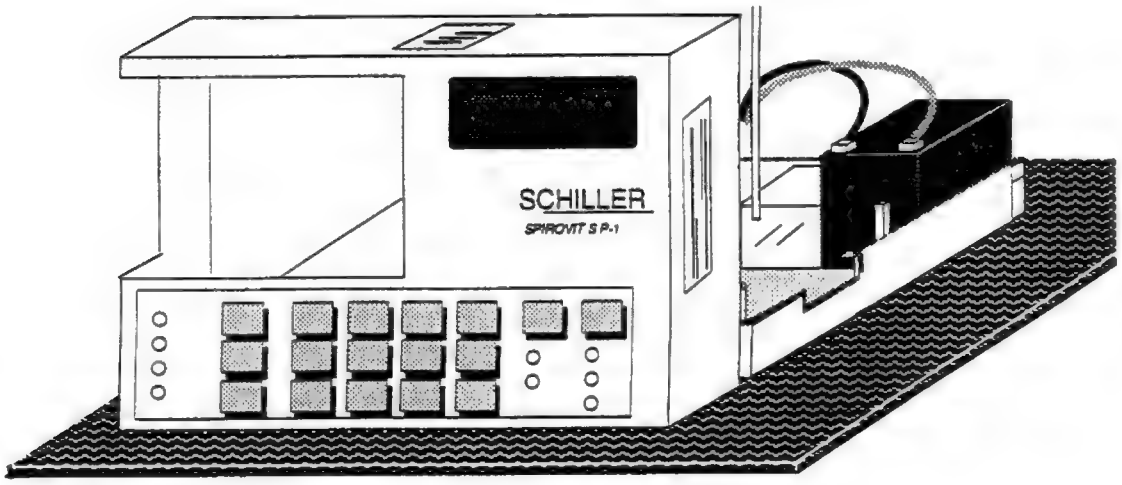
Top Assembly Replacement

To replace the Top Assembly proceed as follows:

1. Check that all boards and components are firmly secured. Check for loose screws. Ensure that no screws or foreign bodies are loose in the bottom of the case.
2. Inspect all the internal cable assemblies and ensure that they are in good condition and that no visible damage can be seen. Ensure that no cable assemblies are strained, crushed or caught.
3. Ensure that all connectors are firmly home.
4. Position the Top Assembly in front of the Base Assembly and without straining the ribbon cable, plug in the interconnecting cables from the Keyboard and from the LCD to the Flow sensor board SP 11-4

   Note: It may be necessary to tilt the Top Assembly for the cable assemblies to reach.

5. Carefully position the Top Assembly on the Base Assembly.
6. Grasping the two assemblies to ensure that they cannot part, carefully turn the unit upsidedown and replace the six securing screws and washers in the extreme corners and edges of the unit. Return the unit to the upright position.
7. Carry out the functional check procedure detailed in Chapter 3.



Exploded View

See Circuit Diagrams and Board Layouts Section.

Flow Sensor / RS Interface SP 11-4

The Flow sensor / RS Interface board is mounted above the Control and Power Supply board SP 11-1 and is secured to six spacers.

Prerequisite

The Warnings and Cautions at the beginning of the Chapter must be observed.

The Top Assembly must be removed and all external cable assemblies disconnected.

Tools and Test Equipment

Cross-bladed posi-drive screwdriver

Parts

Flow sensor / RS Interface board Part number as detailed in Chapter 6.

Board Removal

CAUTION

THE FLOW SENSOR / RS INTERFACE BOARD CONTAINS STATIC SENSITIVE CMOS COMPONENTS. OBSERVE ANTISTATIC PRECAUTIONS.

To remove the board proceed as follows:

1. Unscrew the six screws securing the board to the spacers.
2. Gently raise the board to gain access to the cable assembly to the Control board and remove the two connectors. Remove the board.

Board Replacement

1. Place the flow sensor and RS board component side down over the six spacers and connect the cable assembly to the Control board SP 11-1. Place the board so that the flow sensor connector and the RS connector are positioned in the cutouts on the side panels.
2. Secure the board to the six spacer supports with the retaining screws.

Checks and Tests after Replacement

To prove the integrity of the replaced board carry out the following functional check procedure:

1. Switch on the unit and connect a Flow sensor.
2. Carry out the calibration procedure detailed in Chapter 3.

Battery Pack

The battery pack is held in position with double sided tape.

Prerequisite

The Warnings and Cautions at the beginning of the Chapter must be observed.

The Top Assembly must be removed and all external cable assemblies disconnected.

Parts

The part numbers of all replaceable items are given in Chapter 6.

Battery Pack Removal

WARNING

THE MAINS SUPPLY MUST BE DISCONNECTED DURING THIS PROCEDURE

To remove the Battery Pack proceed as follows:

1. Ensure that the unit is switched off and that the mains is disconnected.
2. Disconnect the two bayonet connectors and remove the Battery Pack by gently pulling away from the base.

Battery Pack Replacement

1. Position the Battery Pack with the connectors towards the inside of the unit.
2. Remove the double-sided tape protective sheet and secure the Battery Pack to the base.
3. Connect the bayonet connectors.

Checks and Tests After Battery Replacement

Program all static settings which will have been lost when the battery was disconnected.

Printer Tray Assembly and Thermal printer

Prerequisite

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed as detailed previously. All external cable assemblies must be disconnected.

Tools

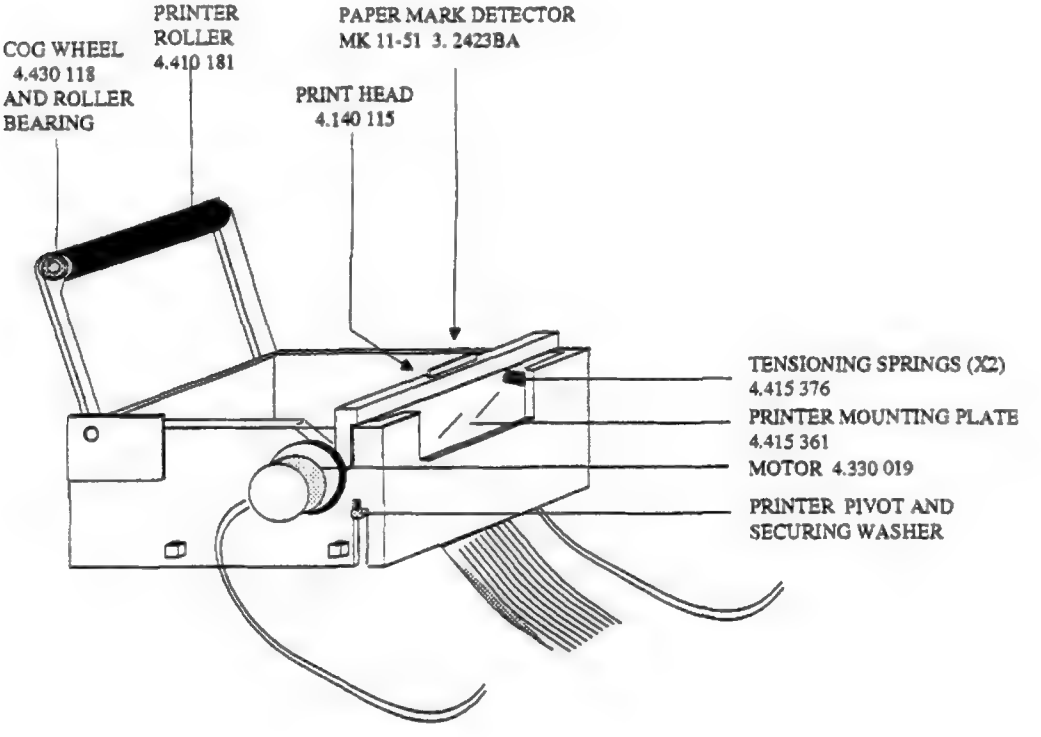
- Cross-bladed screwdriver
- Flat-bladed screwdriver
- Flat ended pliers

Part Numbers

The part numbers for the Thermal Printer Assembly, the print head and the motor are given in Chapter 6.

CAUTION

THE THERMAL PRINTER CONTAINS IS STATIC SENSITIVE; OBSERVE ANTISTATIC PRECAUTIONS



Printer Tray Assembly and Thermal Printer (cont.)

Printer/Paper tray Assembly Removal

1. Remove the following connectors from the Control and Power Supply board SP 11-1 :
   - data connector to the thermal printer
   - earth connector to the printer
   - paper mark connector
   - printer motor connector
2. Unscrew the four retaining screws and remove the complete paper tray/printer assembly.

Thermal Printer Removal

1. Turn the Paper tray/printer assembly upsidedown and unscrew the two retaining printer retaining screws.
2. Gently remove the printer taking care to retain the two tensioning springs.

Thermal Printer Replacement.

To replace the Thermal Printer proceed as follows:

1. Position the Printer in the paper tray/print assembly so that the printer mounting plate lips slot into the dedicated cutouts in the assembly; secure with the two retaining screws. Ensure that the cable assemblies from the printer to the Interface PCB are not caught and are not strained.
2. Using a spring compressor, insert the two tensioning springs so that the springs are positioned over the moulded spring supports and in the indent (hole) in the printer mounting plate.

Printer/Paper tray Assembly Replacement

1. Position and secure in the base the assembly with the four retaining screws.
2. Reconnect the following connectors to the Control and Power Supply board SP 11-1 :
   - data connector to the thermal printer
   - paper mark connector
   - earth connector to the printer
   - printer motor connector
3. Replace the Top Assembly.

Checks, Tests and Adjustments after Printer Replacement

Check the print quality as described in Chapter 3.

Control and Power Supply board SP 11-1

The Control and Power Supply board SP 11-1 is secured to the base tray and positioned under the Flow sensor and RS board SP 11-4.

Prerequisite

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.
- The Flow sensor and RS board SP 11-4 must be removed.
- The Printer Tray Assembly must be removed.

Tools and Equipment

Posi-drive screwdriver

Parts

Control and Power Supply board SP 11-1. Part number as detailed in Chapter 6.

Board Removal

WARNING

ENSURE THAT THE MAINS CABLE IS DISCONNECTED BEFORE COMMENCING

To remove the Control and Power Supply board SP 11-1 proceed as follows:

1. Disconnect the following connectors:
   - live and the neutral bayonet connectors to the battery
   - data connector to the thermal printer
   - paper mark connector
   - earth connector to the printer
   - printer motor connector
   - live and the neutral bayonet connectors to the mains connector

   Tip ! *It may be easier to remove the mains connector together with the control board. In this case disconnect the ground lead from the potential equalisation stud.*

   Note: The two connectors to the flow sensor and RS board will already have been removed as detailed in the previous paragraph.

2. Unscrew the nine spacer fixations (four on the mains transformer) and remove the board. The mains transformer is fixed to the board with double-sided tape.

Control and Power Supply board SP 11-1 (cont.)

Board Replacement

To replace the Control and Power Supply board SP 11-1 proceed as follows:

1. Position the board and secure at the nine fixing points (four on the mains transformer)
2. Connect the following:
   - live and the neutral bayonet connectors to the mains connector (or the ground connector to the potential equalisation stud)
   - live and the neutral bayonet connectors to the battery
   - data connector to the thermal printer
   - paper mark connector
   - earth connector
   - printer motor connector
3. Replace the Flow Sensor / RS Interface SP 11-4 (detailed in the previous paragraph) and reassemble the unit.

Keyboard

The keyboard comes as a complete assembly with the top casing. The parts numbers of the various keyboards are given in Chapter 6.

Chapter 5
Adjustments

Contents

Introduction	*5.2*
Safety Notices	*5.3*
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Proprietary Test Equipment/Tools	*5.4*
Test Setup	*5.5*
Control Board SP 11-1 Component Location	*5.6*
Battery Charge Voltage	*5.7*
Precautions and Requirements	*5.7*
Tools and Equipment	*5.7*
Procedure	*5.7*
Paper mark Detector	*5.8*
Tools, Equipment and Material	*5.8*
Procedure	*5.8*

Introduction

This Chapter provides the procedures necessary to check and adjust all service settings. Every procedure is self-contained and details the tools required to carry out adjustments, and the test equipment necessary. Any adjustments, jumper settings, special checks or functional tests that are required on the module, or on associated modules or software, are also detailed.

In-text diagrams support the text where required and provide location details of connectors, test points and adjustment potentiometers.

Specific warnings and cautions are given in the text where applicable.

The part numbers for all replaceable modules are given in Chapter 6.

The SP-1 has the following adjustments:

- Battery Charge Voltage (VR1 on the Microprocessor/Power supply Board (SP 11-1))
- Paper Mark Detector (VR2 on the Microprocessor/Power supply Board (SP 11-1))

Safety Notices

WARNING

MAINS POWER IS POTENTIALLY LETHAL - DISCONNECT THE MAINS BEFORE DISASSEMBLING THE UNIT. ADDITIONALLY ENSURE THAT THE MAINS IS DISCONNECTED BEFORE CARRYING OUT ANY MAINTENANCE, CALIBRATION, CHECKS, OR ADJUSTMENTS.

CAUTIONS

THE SP-1 CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTISTATIC PRECAUTIONS. WHEN CARRYING OUT ANY MAINTENANCE PROCEDURES ALWAYS PLACE THE UNIT ON AN EARTHED ANTISTATIC MAT. PERSONNEL MUST BE EARTHED WHEN HANDLING ANY BOARDS OR COMPONENTS. ALWAYS USE AN ANTISTATIC BAG WHEN TRANSPORTING BOARDS OR COMPONENTS

CARE MUST BE TAKEN WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

THE PROCEDURAL STEPS GIVEN FOR EACH MODULE MUST BE FOLLOWED IN THE ORDER GIVEN.

THE OUTER SURFACES OF THE SP-1 ARE SUSCEPTIBLE TO ABRASION DAMAGE. TO PREVENT SCRATCHING, ALWAYS PLACE ON A SOFT, NON-ABRASIVE CLOTH.

Conditions

The unit must be placed on an antistatic mat and antistatic precautions observed when any maintenance is carried out on the SP-1.

The room temperature should be between 18 and 28 degrees.

Note: When a key operation or menu selection is required in the following procedures, the key sequence required is given in parenthesis `<>'. The character, or character string, given in parenthesis is the actual character, or character string, printed on the key.

Test Equipment

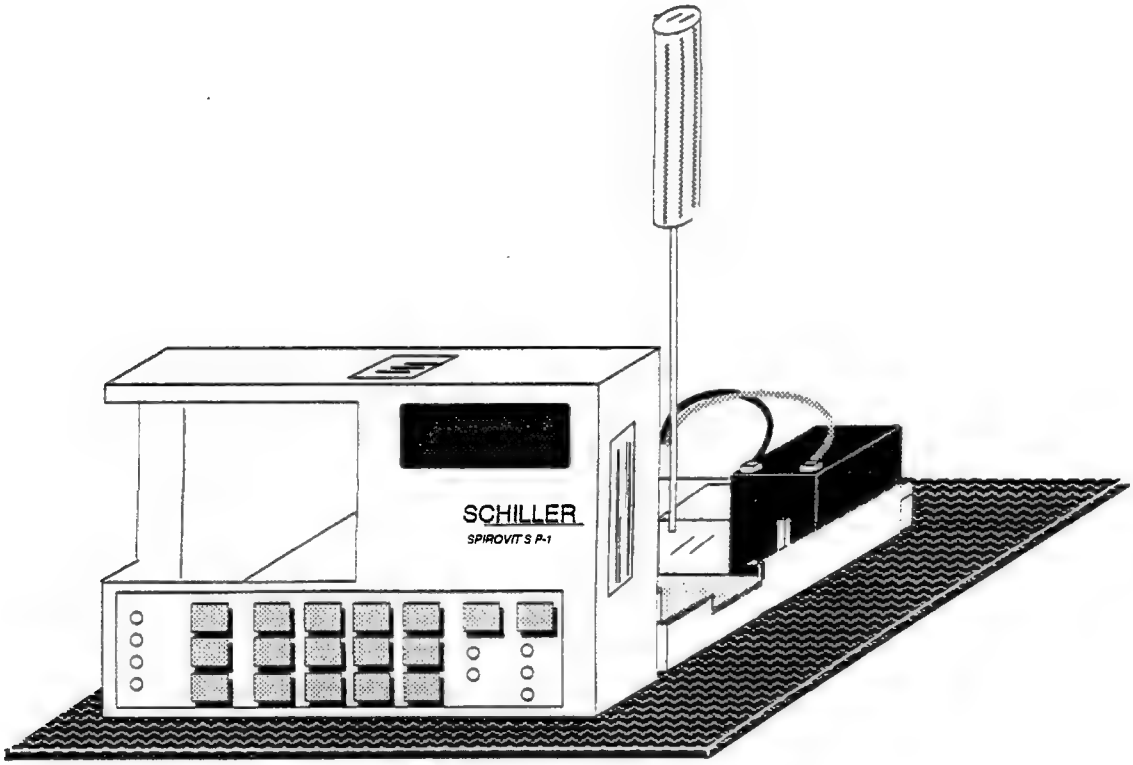
The following proprietary and dedicated test equipment is required to fault find and carry out all board checks and adjustments on the SP-1.

The list of proprietary equipment is not comprehensive. Recommendations of suitable proprietary test equipment can be obtained from the SCHILLER Service Department.

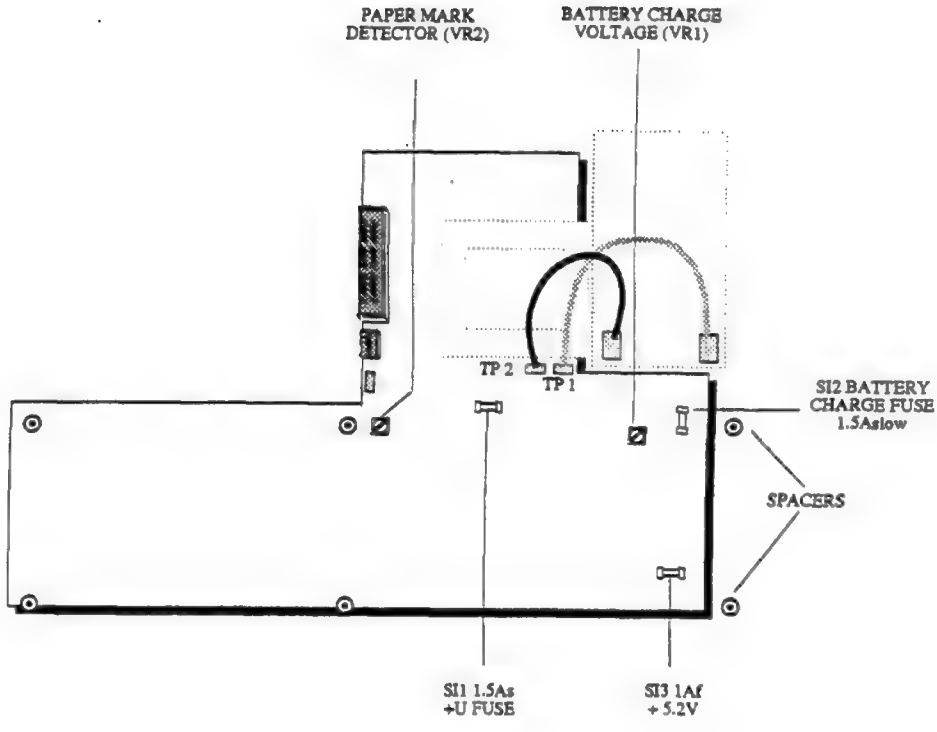
Proprietary Test Equipment/Tools

- Oscilloscope
- Digital Multimeter
- Standard tool kit with a selection of cross-bladed, flat-bladed and posi-drive screwdrivers, pliers and general tools
- Flow Sensor

Test Setup



Control Board SP 11-1 Component Location



Battery Charge Voltage

Precautions and Requirements

The unit must be placed on an antistatic mat and antistatic precautions observed when any maintenance is carried out on the SP-1. The room temperature should be between 18 and 28 degrees.

Tools and Equipment

- Digital voltmeter
- Small flat bladed screwdriver
- Resistor 2.7kOhms, 250mW

Procedure

The battery charge voltage is nominally 13.5V (with a nominal maximum current of approximately 5mA). Adjust and check as follows:

- DISCONNECT THE MAINS SUPPLY
- Disassemble the unit as detailed in Chapter 4 and remove the flow sensor /RS interface SP 11-4.
- Remove the two battery connectors and connect a 2.7 kOhm 250mW resistor across the two connectors (TP1 and TP2) to simulate a discharged battery. Connect the digital multimeter across the resistor.
- Connect the Mains supply.

WARNING

EXERCISE CARE - BE AWARE THAT POTENTIALLY LETHAL VOLTAGES ARE PRESENT

- Adjust VR1 to obtain a charging voltage of 13.5V.
- Disconnect the mains supply and the resistor from TP1 and TP2.
- Reconnect the battery and reassemble the unit as detailed in Chapter 4.

Paper mark Detector

Tools, Equipment and Material

- Digital voltmeter
- Small flat bladed screwdriver
- 70% alcohol solution and clean lint free cloth

Procedure

To adjust the paper-mark Schmitt trigger sensitivity proceed as follows:

- DISCONNECT THE MAINS SUPPLY
- Open the paper tray lid and clean the photocell (situated on the opposite side to the dc motor) with a 70% alcohol solution. Allow to completely dry.
- Disassemble the unit as detailed in Chapter 4 and remove the flow sensor /RS interface SP 11-4.
- Pull the paper slowly through the roller and paper mark detector).
- Measure the voltage at U4 pin 3. Adjust VR2 to achieve the following:
  - no paper-mark (white paper) 0.5V ±0.1V
  - paper mark (black paper) > 2.5V
- Reassemble the unit as detailed in Chapter 4.

Chapter 6
Spare Parts

Contents

Introduction	***6.2***
Module Identification	*6.3*
Spare Parts	***6.5***
Accessories	***6.6***

Introduction

This Chapter gives the part numbers for modules that can be replaced by the service engineer. The part numbers for disposables, accessories and dedicated test equipment are also included.

When ordering state that the module required is for an SP-1 unit and provide the following:

- Part Title
- Part Number
- Software Version *
- Serial number of the unit *
- Your company address and a contact name

* The software version and the serial number of the unit are found on the software screen (details in Chapter 4). The serial number is especially necessary when ordering mechanical parts to ensure that the correct version is identified by the processing department.

Additionally if you are returning a faulty module the following information, in as much detail as possible, will speed repair:

◊ the exact nature of the fault

◊ the circumstances, and function being carried out, when the fault occurred

IT IS RECOMMENDED THAT RETURNED MODULES ARE SENT BY REGISTERED POST.

IMPORTANT

ALL BOARDS AND STATIC SENSITIVE MODULES MUST BE RETURNED IN A SEALED STATIC SHIELDING BAG. NO RESPONSIBILITY CAN BE ACCEPTED FOR MODULES NOT SENT IN THIS WAY

The address to send your order is:

Schiller AG

Sales Department (Order Processing)

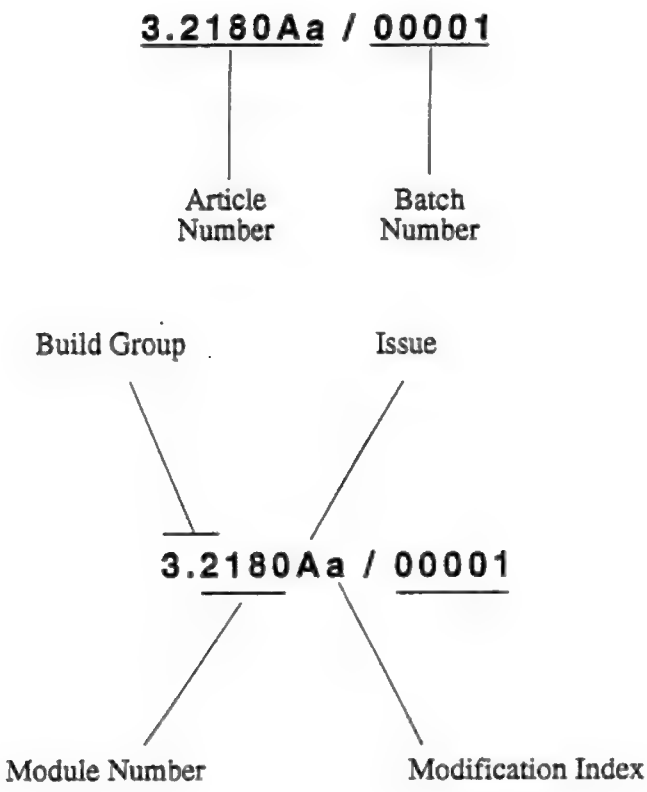
Altgasse 68

6340 Baar

Switzerland

Module Identification

Every module has a unique part number. The number is either stencilled on the module or printed on an attached label. The module numbers are arranged as follows:



When ordering a module, only the article number has to be stated (without the modification index). The Batch number is a manufacturing identification number and need not be stated unless a module is suspected of having a manufacturing fault.

The article number is divided as follows:

Build Group Number	This number identifies the type of module or module group, for example electrical (PCB), mechanical, component etc.
Module Number	The individual module number
Issue Letter	This is always an upper case letter and gives the issue state of the module
Modification Index	This lower case letter gives the modification or build state of the module. It is applicable only for the specific Issue

The documentation associated with a module, is identified by a letter in place of the module build group number. For example the processor board for the AT-60 ECG unit without the Spirometry option, has the article number **3.2180Ga.**

The Circuit Diagram is **S.2180Ga,**

The Block Diagram is **B.2180Ga**

The Component Layout is **D.2180Ga.**

The categories are as follows:

DOCUMENT	IDENTIFICATION LETTER
CIRCUIT DIAGRAM	S
BLOCK DIAGRAM	B
COMPONENT LAYOUT	D
TEST DOCUMENTATION	P
ASSEMBLY DOCUMENTATION	F

Note that the Test Documentation and Assembly Documentation is usually available for internal use only.

Spare Parts

DESCRIPTION	PART NUMBER
MICROPROCESSOR AND POWER SUPPLY BOARD SP 11-1D	3. 2285DB
FLOW SENSOR AND RS INTERFACE BOARD SP 11-4D	3. 2286DA
PAPER MARK SENSOR BOARD MK 11-51	3. 24 23BA
KEYBOARD PRINT MK 11-3C	3. 2422CA
SP-1 SOFTWARE (PROGRAMMED EPROM)	5. 540 001
BOTTOM HOUSING COMPLETE	4. 310 142
TOP HOUSING WITH KEYBOARD AND LCD COMPLETE (ENGLISH)	4. 310 154
RUBBER KEYBOARD (ENGLISH)	4. 450 242
RUBBER KEYBOARD (GERMAN)	4. 450 241
RUBBER KEYBOARD (FRENCH)	4. 450 243
RUBBER KEYBOARD (ITALIAN)	4. 450 244
RUBBER KEYBOARD (SPANISH)	4. 450 245
RUBBER KEYBOARD (PORTOGUESE)	4. 450 255
KEYBOARD FOIL (ENGLISH)	4. 450 247
KEYBOARD FOIL (GERMAN)	4. 450 246
KEYBOARD FOIL (FRENCH)	4. 450 248
KEYBOARD FOIL (ITALIAN)	4. 450 249
KEYBOARD FOIL (SPANISH)	4. 450 250
KEYBOARD FOIL (PORTOGUESE)	4. 450 256
PAPER TRAY ASSEMBLY	4. 310 138
PAPER TRAY LID	4. 310 137
THERMAL PRINT HEAD	4, 140 115
GROUND SHIELD	4. 416 028
TRANSFORMER SHIELD	4. 416 027
FLOW SENSOR /RS INTERFACE ISOLATION SHIELD	4. 416 040
MAINS SOCKET COMPLETE	4. 270 009
MAINS FUSE HOLDER	4. 210 049
MAINS FUSE - 200M/AT	4. 210 010
MAINS TRANSFORMER	4. 320 066
12V LEAD ACID BATTERY	4. 350 024
PRINTER MOTOR COMPLETE	4. 330 019
THERMAL PRINT HEAD	4. 140 115
THERMAL PRINT HEAD CABLE	4. 520 378
PRINTER ROLLER	4. 410 181
POTENTIAL EQUALISATION STUD	4. 260 37

Accessories

DESCRIPTION	PART NUMBER
PULMONARY FUNCTION MEASUREMENT UNIT SPIROVIT SP-1	3. 911 100
PACK OF PRINTER PAPER Z FOLDED	2. 157 014
POTENTIAL EQUALISATION CABLE	2. 310 005
CALIBRATION PUMP 2 LITRES	2. 100 027
PNEUMOTACHO SENSOR SP-150	2. 200 520
PACK OF 10 DISPOSABLE SENSORS FOR SP-150	2. 100 077
PNEUMOTACHO SENSOR SP-20	2. 200 540
PACK OF 100 FILTERS FOR SP-20	2. 100 123
USER GUIDE ENGLISH / GERMAN	2. 510 196
USER GUIDE FRENCH / ITALIAN	2. 510 197
USER GUIDE PORTUGUESE / SPANISH	2. 510 198
USER GUIDE USA	2. 510 271
USER GUIDE RUSSIAN	2. 510 301

Chapter 7
Technical Data

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RS-232 (V24) Interface 7.3

Technical Data

Technical data subject to change without notice.

Safety standard:	BF according to IEC and complying with the following:
	CE-0124 Notified Body ,DEKRA
	RL 93/42/EEC
	EN 60601-1:1990
	IEC 601-1
	pr EN 1441:1994
	IEC 513:1994
Protection class:	I according to IEC, VDE, SEV
	IIa according to RL 93/42/EEC
Dimensions (l/w/h):	290 x 210 x 69 mm: 11.4 x 8.3 x 2.7 ins
Weight:	2.9 kg: 6.3lbs
Mains Supply:	100 to 115 / 220 to 240 VAC, 50/60 Hz
LCD	Liquid crystal, display for graphic and alpha numeric representation
	Resolution - 192 x 64 dots variable contrast
Battery:	Built-in 12 V lead-acid battery (rechargeable).
	Normal working time - 7 hours
	Charging time - 15 hours for a completely discharged battery (<6 hours to 90%)
Power Consumption:	28 VA max.
Control Panel:	Splashproof Rubber keys
Storage:	Memory for 100 measurements
Paper Speed:	25 mm/s
Chart Paper:	Thermoreactive Z-folded, 90 mm wide, perforation 90mm (3.54 ins)
Printing Process:	High-resolution thermal print head

Technical Data

Method of Measurement:	Pneumotachometer
Measurement Ranges:	Flow: 0 to ±14 l/s; Volume: 0 to ±11 litres
Measurement Accuracy:	±2%
Flow Impedance:	Less than 0.2 mbar * s/l at 12 l/s
Measured Values:	FVC, ERV, IRV, TV, FVC, $FEV_{0.5}$, $FEV_{1.0}$, $FEV_{3.0}$, $FEV_{0.5}$/SVC, $FEV_{1.0}$/FVC, $FEV_{3.0}$/VC, $FEF_{0.2-1.2}$ (litres), $FEF_{25-75\%}$, $FEF_{75-85\%}$, PEF, $MEF_{75\%}$, $MEF_{50\%}$, $MEF_{25\%}$, MV, MVV, FIVC, $FIV_{1.0}$, $FIV_{1.0}$/FIVC, $FIV_{1.0}$/FVC, PIF, $MIF_{50\%}$.
	Comparison pre/post medication possible.
	Extrapolated predicted values
Prediction Equation:	Adults: ECCS / Austria / Berglund / Finnish / Indian / Morris / Crapo / Knudson / Knudson 76 / Polgar / Composite
	Children: Quanjer & Tammeling / Austria / Indian / Knudson / Knudson 76 / Polgar
Standards Compliance:	ATS, OSHA, NIOSH
Environmental Conditions:	Temperature, Operating: 10° to 40° C
	Temperature, Storage: -10° to 55° C
	Relative humidity: 25 to 95% (non condensing)
	Atmospheric pressure: 700 to 1060 hPa

RS-232 (V24) Interface

Protocol:	Asynchronous
Baud Rate:	300 to 38400 Baud
Byte Format:	1 start bit, 8 data bits 0 or 1 parity bit (+ or -), 1 stop bit
Transfer Control:	By means of CTS, RTS
Connection Socket:	3 x D subminiature (9 pole female), wired as DTE (Data Terminal Equipment).
Pin Connections:	Pin 3 TXD1 O (output data)
	Pin 2 RXD1 I (input data)
	Pin 7 RTS1 O (request to send)
	Pin 8 CTS1 I (clear to send)
	Pin 5 GND (ground)

Chapter 8
Glossary

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Explanation of Measured Values 8.8

Introduction

The following list provides a glossary of the important signals and acronyms used in the circuit diagrams for the SCHILLER instruments. They will not all apply to the SP-1.

Only abbreviations that are specific to SCHILLER equipment are included here. General electrical and electronic abbreviations are not included.

Acronyms

..OS	Offset signal (on the ECG amplifier)
A(1..n)	CPU Address Bus.
ALBEEP	Alarm beeper signal to the audio amplifier. The frequency of this signal is about 1000 Hz.
ANA1, ANA2	Analog input from the experimental inputs DC1 and DC2.
AS	Address strobe
BATT	Signal to CPU indicating battery operation
BATTLC	Analog signal to the processor giving the charge condition of the battery.
BATTV	Battery voltage - analog signal from the power supply used by the processor to assess battery or mains operation.
BLOW	Battery less than 11.3V. LCD flashes when this signal is active. When the battery voltage drops to below approximately 9.4V the unit is switched off. These values apply to equipment with 12 V battery. For other equipment the limits are different.
CHAD ..	ECG signal multiplexer control signals (on the ECG Amplifier)
CIF(0..16)	Communication interface. General control signals for the communication interface circuits.
CI(0..10)	RS interface control lines - input.
CO(0..10)	RS interface control lines - output.
CL1	19 kHz LCD latch pulse.
CL2	3.11 MHz LCD clock frequency.
CLK..	Clock Signal. The number following the CLK indicates the frequency. For example CLK 19 indicates a frequency of 19 MHz.
CS..	Chip select. The general format of the chip select signals is CS followed by some characters. The characters indicate the device to which the chip select signal appertains. For example CSRTC is the chip select signal for the real time clock and CSEPROM is the select signal fot the EPROM etc.
CTS	Clear to send. General signal used in data communication.
D (0..15)	Data Bus
DACWR	Digital / analog converter wire.
DIO..	Data input/output on the Data I/O connector
DMUX	Data multiplexer.
DRAM	Dynamic RAM
DRC(0..6)	Dynamic RAM control.
DS..	Data strobe.

Acronyms

DSP..	Digital signal processor (on program pack).
DTACK	Transfer data acknowledge. Bus signal to acknowledge transfer of data.
DTR	Outgoing serial data, turns modem on.
ECG1	ECG in - serial ECG data to the CPU sent over the optical interface.
ECGMUX	The multiplexed ECG signal from the ECG amplifier.
ECGO	ECG out - serial ECG amplifier control data from the CPU sent over the optical interface.
EF	Empty flag.
EJCT	Eject (paper tray).
EKGRES	Reset signal to the ECG Amplifier. This signal resets the ECG Amplifier to recenter the ECG image on the LCD.
FIFOR	First in first out read.
FLM	Control signal for frame synchronisation of the LCD.
FPIN	Input for floating point co-processor.
FWR	Flag read / write.
HREN	Output enable signal for thermal print head data (History enable).
HSYNC	Horizontal synchronisation (video / VGA output).
IPL0..2	Interrupt priority level (binary encoded).
IREG	Control signal from the current detector and limiter circuit on the power supply to regulate supply.
ISYS	Interrupt system (2 kHz).
KB..	Keyboard data in.
KBBEEP	Keyboard beep (to audio amplifier).
KBCLR	Keyboard clear.
KBCL1	Keyboard clock.
KBCL2	Keyboard clock.
KBIN..	Keyboard data in - serial data from the keyboard to the CPU.
KBS..	Keyboard Strobe.
KONV	Convert - this signal initiates the conversion of the incoming signal from the ECG Amplifier..
LA	Left Arm.
LCA	Liquid crystal address - enable.
LCDAS	LCD Address Strobe.

Acronyms

LCDKONT	LCD contrast - sets the -18 V voltage level (from which the LCD backlight power is generated) and thus the contrast of the screen.
LCDW	LCD Write.
LD1,2,3,4	Lower LCD data.
LDS	Lower data strobe.
LED (0..3)	Operate signals to the LED indicators on the keyboard.
LEDB	Battery LED.
LEDMAINS	Signal indicating mains connected - to operate LED indicator on the keyboard.
LOE	Lower output enable - control signal for static Ram.
LP	Line synchronisation.
LSRAM	Lower output enable - control signal for static RAM.
LWE	Lower Write Enable - control signal for Static Ram.
M	LCD control signal derived from FLM.
MCLK	Motor Clock - speed control for the printer motor.
MOD	Control signal from the battery charging circuit.
MOFF	Motor off.
MON	Motor On - Printer motor enable signal.
NWTZ	Mains supply.
NMI	Non-maskable interrupt - interrupt for U47 (Schiller gate array) activated by the reset button.
OFF	Off signal from the OFF key to switch off the power supply.
PDS	Control signal derived from FLM (unity waveform 1/2 FLM frequency).
PM	Paper mark signal.
PMARK	Paper mark detection signal.
PMPON	Pacemaker detection pulse.
PMNEG	Pacemaker negative - indicates the trailing edge of a pacemaker pulse.
PMPOS	Pacemaker positive - indicates the leading edge of a pacemaker pulse.
PWM	Pulse Width Modulation
QTRRG	QRS trigger - output signal.
RA	Right Arm.
RAS	Row address strobe.
RES	Reset.

Acronyms

RESLCD/	Resets / darkens the LCD.
RES/P	Error reset signal to inactivate the LCD.
RTS	Ready to send - ougoing serial data, handshake with CTS.
RXD	Receive data - incoming serial data.
R / W	Read / Write
SC(0..8)	System control bus - CPU control signals.
SCINV	Screen inversion.
SI	Serial in.
SO	Serial output from the CPU to the ECG amplifier via opto isolators.
SP..	Spirometry control and data signals.
SRAM	Static RAM memory.
STRB1/2	Timing signals for printer control.
SYSEN	System enable - active when the program pack is inserted. The CPU will not work if this signal is not active.
TGATE	Gate pulse for programmable timer. This signal sets the TPDUR signal.
TM	Thermal printer temperature - dc voltage from the print head, pulse width modulation of signal TPTH.
TPC	Thermal printer clock. This is not a continuous clock signal but is active when loading a line of printer data (into shift registers).
TPCLK	Thermal printer clock.
TPD	Thermal printer data - serial data for the printer.
TPDUR	Thermal printer duration - duration of the strobe pulse dependant on the ambient temperature of the print head and the resistance of the print head.
TPCSEL	Thermal printer controller select - control of thermal printer FIFO (input memory buffer).
TPL	Thermal printer latch - print strobe control and data latch signal.
TPRES	Thermal printer reset - FIFO reset for thermal printer controller.
TPS 0 & 1	Thermal Printer Strobe - master timing strobe enable signal.
TPTH	Thermal Printer temperature - dc voltage from the print head to ADC, approximately 3.7V at room temperature.
TS	Temperature sense (from battery).
TXD	Outgoing serial data.

Acronyms

µPOFF	Off control signal. Logic 1 keeps the unit switched on, Logic 0 switches the unit off . Note that the unit is initially switched on directly from the ON key on the keyboard.
U1,2,3,4	Upper LCD data.
+UB	Battery voltage.
UCAS	Upper column address strobe (for dynamic RAM).
UD1, UD2	Upper data strobe - used for generating UOE and UWE.
UDS	Upper Data Strobe - used on the SCHILLER gate array.
UOE, USRAM	Upper output enable - for static RAM.
+UP	Voltage rectified from the mains input and regulated to approximately + 15 V.
UWE	Upper Write Enable - for static RAM.
+U	Unregulated dc supply from mains (approximately 30 V).
+UBU	Back-up voltage for the real time clock and static RAM.
+UD	Unswitched regulated dc voltage used as power source for the switched supply +US. The voltage is 13.5V when mains is connected, or battery voltage when mains is not connected. When mains is connected, this supply charges the battery.
-ULCD	Contrast voltage to LCD.
+US	Switched dc voltage of 13.5V when mains is connected or battery voltage when working from the battery. Input voltage for all PSUs on the power supply board.
VCC	+5 V.
VMA	Valid memory address.
VPA	Valid peripheral address.
VSYNC	Vertical synchronisation - (video / VGA output).
WP0 and WP1	ECG In - the serial multiplexed ECG serial data to the CPU sent over the optical interface, from the ECG Amplifier.
XD0..XD3	Pixel information.
XSCL	Shift clock for XDn.
YD	Frame synchronisation.
YDIS/	LCD off.
ZEROSET	Baseline reset (on the ECG amplifier) from the processor.

Explanation of Measured Values

FVC	**Forced (expiratory) Vital Capacity.** Volume achieved by the quickest possible exhalation after a maximal inhalation.
$FEV_{0.5/1.0/3.0}$	**Forced expiratory volume.** Lung volume in litres, measured after 0.5, 1.0 or 3 seconds forced expiration.
FEF	**Forced Expiratory Flow Respiratory.** Flow in terms of differing lung volumes measured in litres per second.
$FEF_{25-75\%}$	flow speed of the expired air by 25 to 75% of the forced vital capacity (FVC)
$FEF_{75-85\%}$	flow speed of the expired air by 75 to 85% of the forced vital capacity (FVC)
$FEF_{25\%}$	flow speed of the expired air by 25% of the forced vital capacity (FVC)
$FEF_{50\%}$	flow speed of the expired air by 50% of the forced vital capacity (FVC)
$FEF_{75\%}$	flow speed of the expired air by 75% of the forced vital capacity (FVC)
$FEF_{.2-1.2}$	averaged flow between 0.2 and 1.2 litres of the forced expired vital capacity
PEF	**Peak Expiratory Flow**
MEF	Maximal Expiratory Flow
$MEF_{75\%}$	flow speed of the expired air by 25% of the forced vital capacity (FVC)
$MEF_{50\%}$	flow speed of the expired air by 50% of the forced vital capacity (FVC)
$MEF_{25\%}$	flow speed of the expired air by 75% of the forced vital capacity (FVC)
$MEF_{75\%} = FEF_{25\%}$	
$MEF_{50\%} = FEF_{50\%}$	
$MEF_{25\%} = FEF_{75\%}$	
ERV	**Expiratory Reserve Volume.** Possible further expiration starting from the normal expiration level
IRV	**Inspiratory Reserve Volume.** Possible further inspiration starting from the normal inspiration level
TV	**Tidal Volume.** Expirational and inspirational volumes during normal respiration
SVC	**Slow Vital Capacity.** Lung volume measured from a complete expiration following a deep inspiration

Explanation of Measured Values (cont.)

MV	**Expired or Minute Ventilation.** Volume of expired air in litres per minute measured over a minimum of one minute
MVV	**Maximum Voluntary Ventilation.** Maximum volume of air which can be moved on expiration while breathing as deeply and as rapidly as possible
RR	**Respiration Rate**
FMFT	**Forced Mid-expiratory Flow Time.** Time difference between the 25% and 75% points of the FVC
FIVC	**Forced Inspiratory Vital Capacity.** Inspiration volume achieved between a maximal expiration and a maximal inspiration
$FIV_{1.0}$	forced inspiratory air volume in litres measured in the first second
$FIV_{1.0}$ / FIVC	forced inspiratory air volume measured in the first second as a percentage of forced inspiratory vital capacity
$FIV_{1.0}$ / FVC	forced inspiratory air volume measured in the first second as a percentage of forced expiratory vital capacity
PIF	**Peak Inspiratory Flow.** Maximum inspiratory flow speed in litres / second
MIF	**Maximum Inspiratory Flow.** Maximum inspiratory flow in litres
$MIF_{50\%}$	flow speed by 50 % of the forced inspiratory vital capacity

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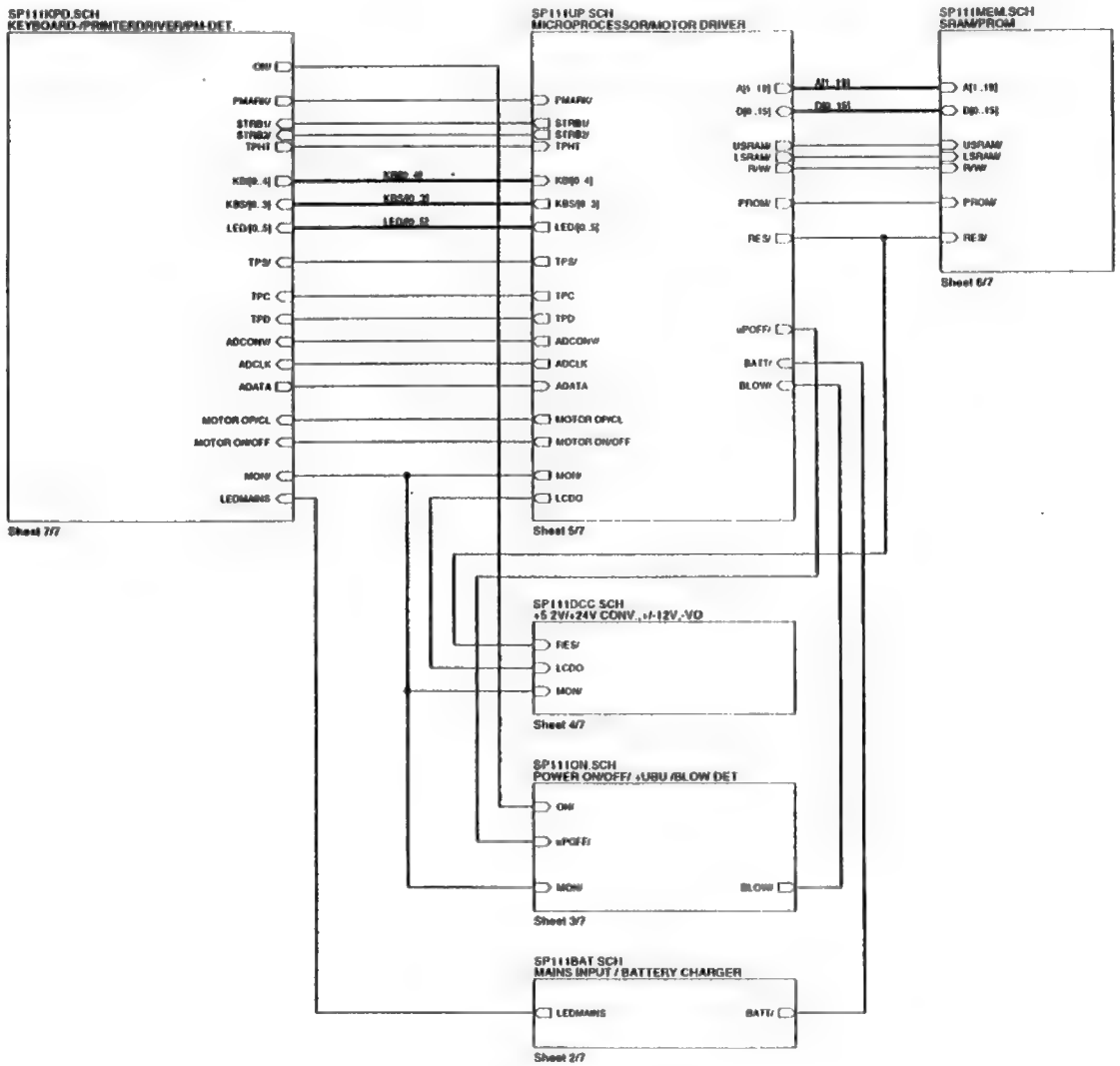
Service Handbook Document History SP-1

Service Handbook Issue 2 July 1998 Art. No. 2. 540 011 Delivery date: 16.07.98

							Receipt Acknowledged						
Unit	Detail	Article Number	Drawing date	Description	HW	Delivery date	DE	AU	IT	FR	US	CAN	CHD
SP-1	SPAD1	REV-Aa	03.04.95	PROM-Adapter									
SP-1	MK11-51	2423Aa	20.06.94	PM-Detector AT-1/4/104 SP-1									
		2423Ba	13.12.94			16.07.98							
SP-1	SP11-1	2285Aa	30.03.95	Microprocessor/Power Supply									
		2285Ba	16.05.95										
		2285Bb	18.07.95										
		2285Bc	07.11.95										
		2285Ca	18.07.95										
		2285Cb	11.09.95										
		2285Cc	07.11.95										
		2285Cd	07.11.95										
		2285Da	02.08.96										
		2285DB	23.01.97										
		2285EA	17.03.98										
		2285EB	09.07.98			16.07.98							
SP-1	MK11-3	2422Aa	11.07.94	Keyboard Print AT-1 SP-1									
		2422Ba	08.11.95			16.07.98							
SP-1	SP11-4	2286Aa	28.02.95	RS-232/FlowSens. Interface									
		2286Ba	09.05.95										
		2286Bb	06.11.95										
		2286Bc	07.11.95										
		2286Ca	28.02.96										
		2286Da	20.08.96			16.07.98							
SP-1 R	SP11-4	2287Da	20.08.96	RS-232/FlowSens. Interface		16.07.98							



Microprocessor/Power Supply SP11-1 (SP-1/SP-1R)				S.2285EB	Schiller AG Altgasse 68 CH-6340 Baar
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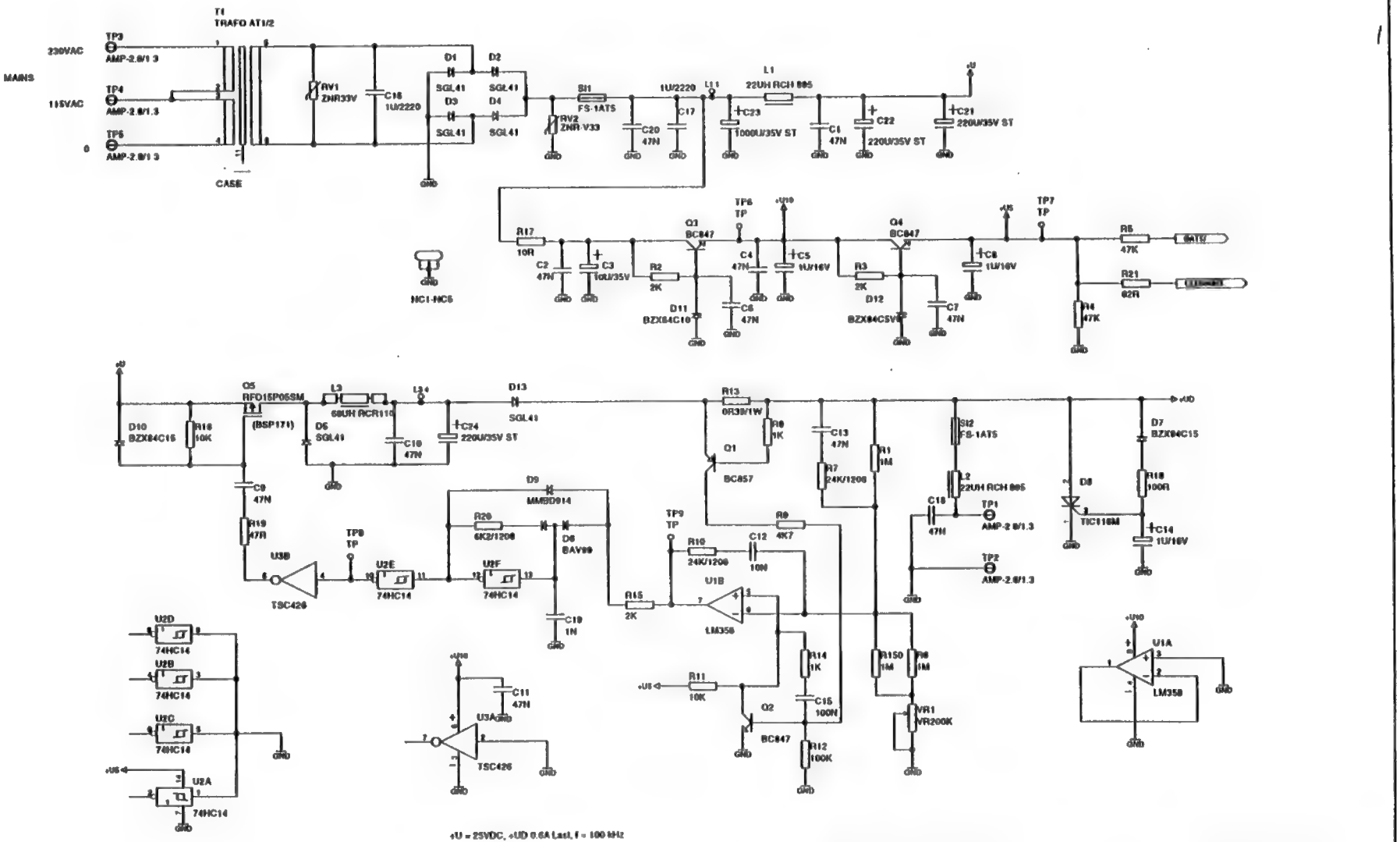
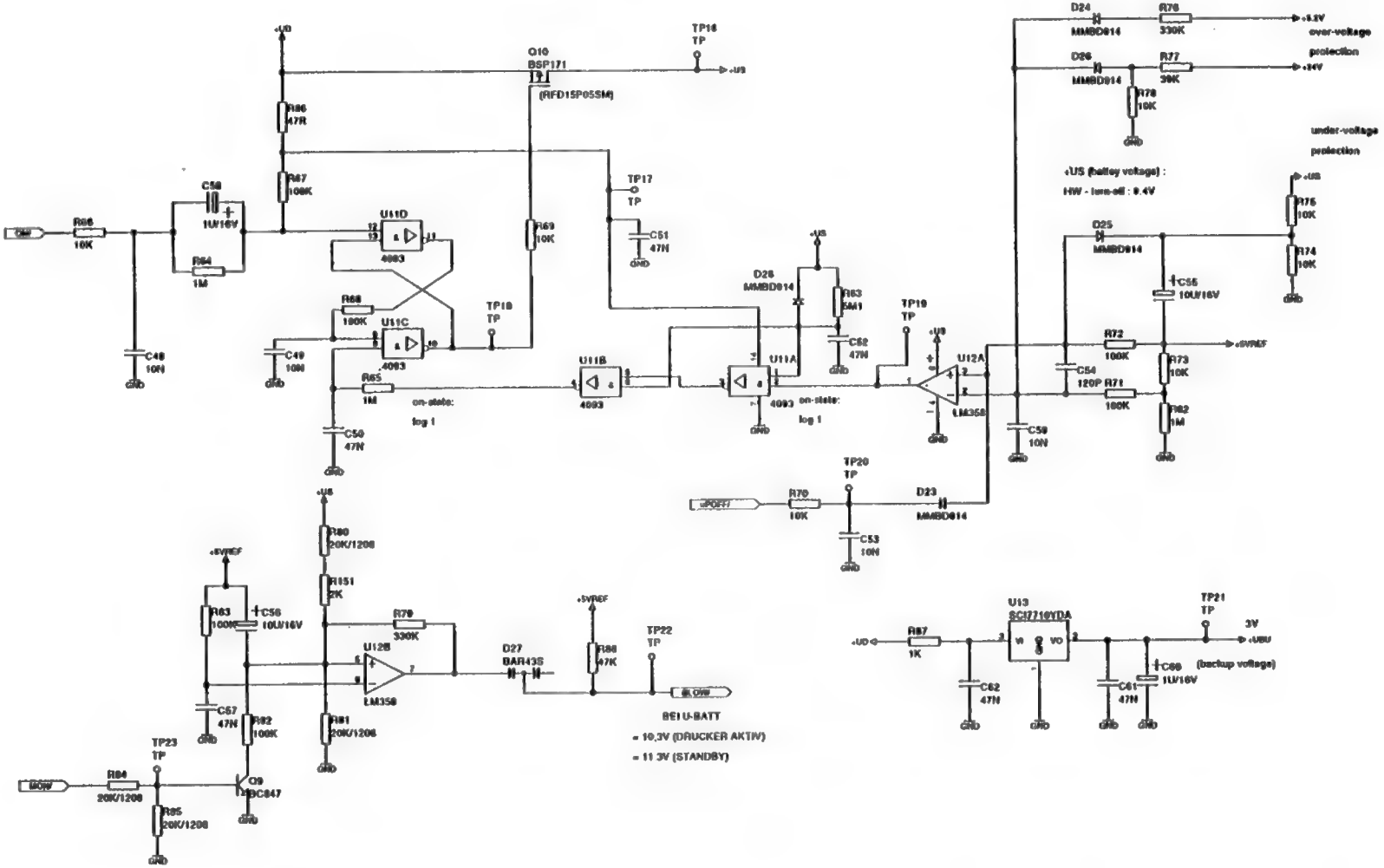
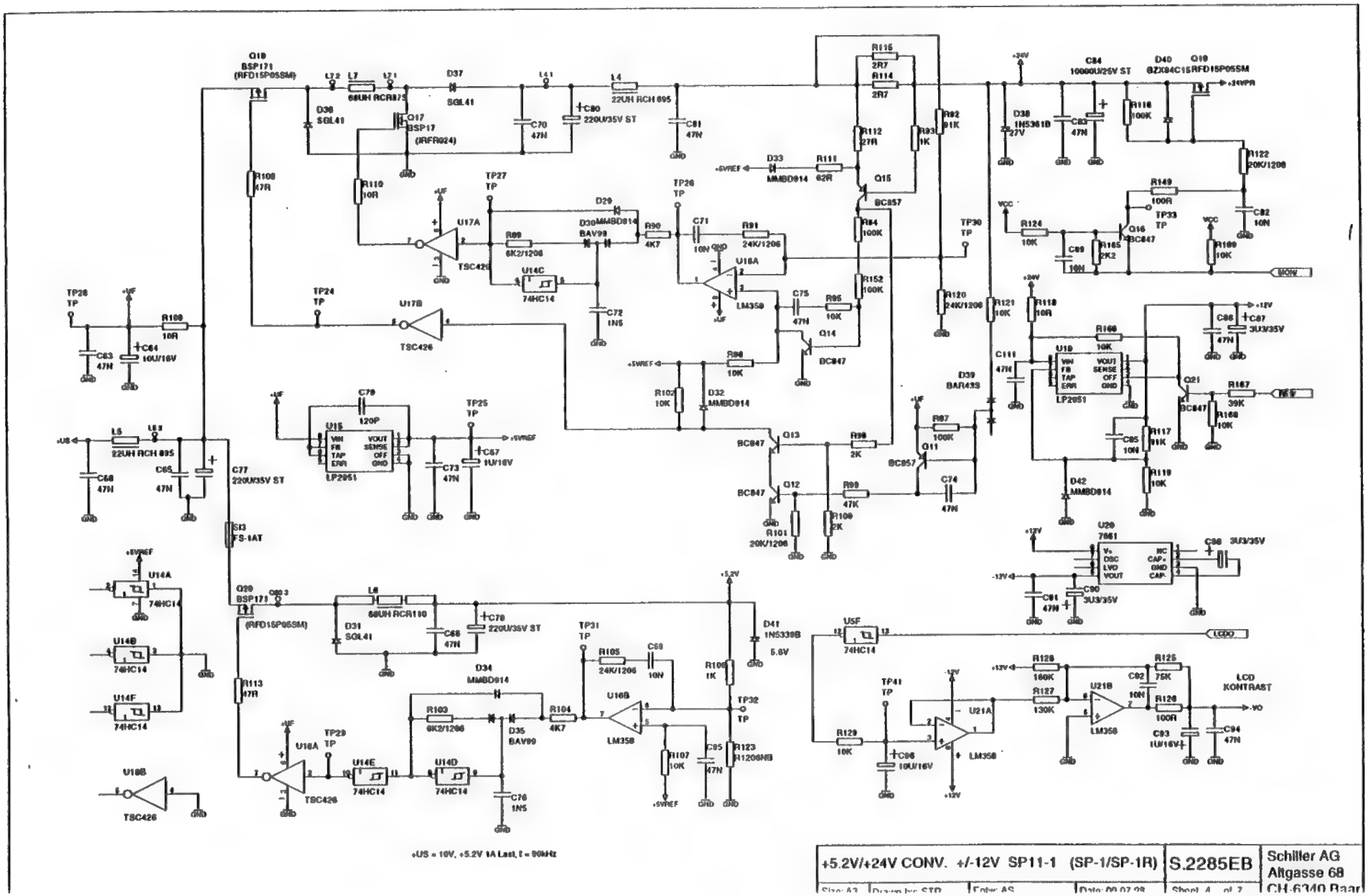
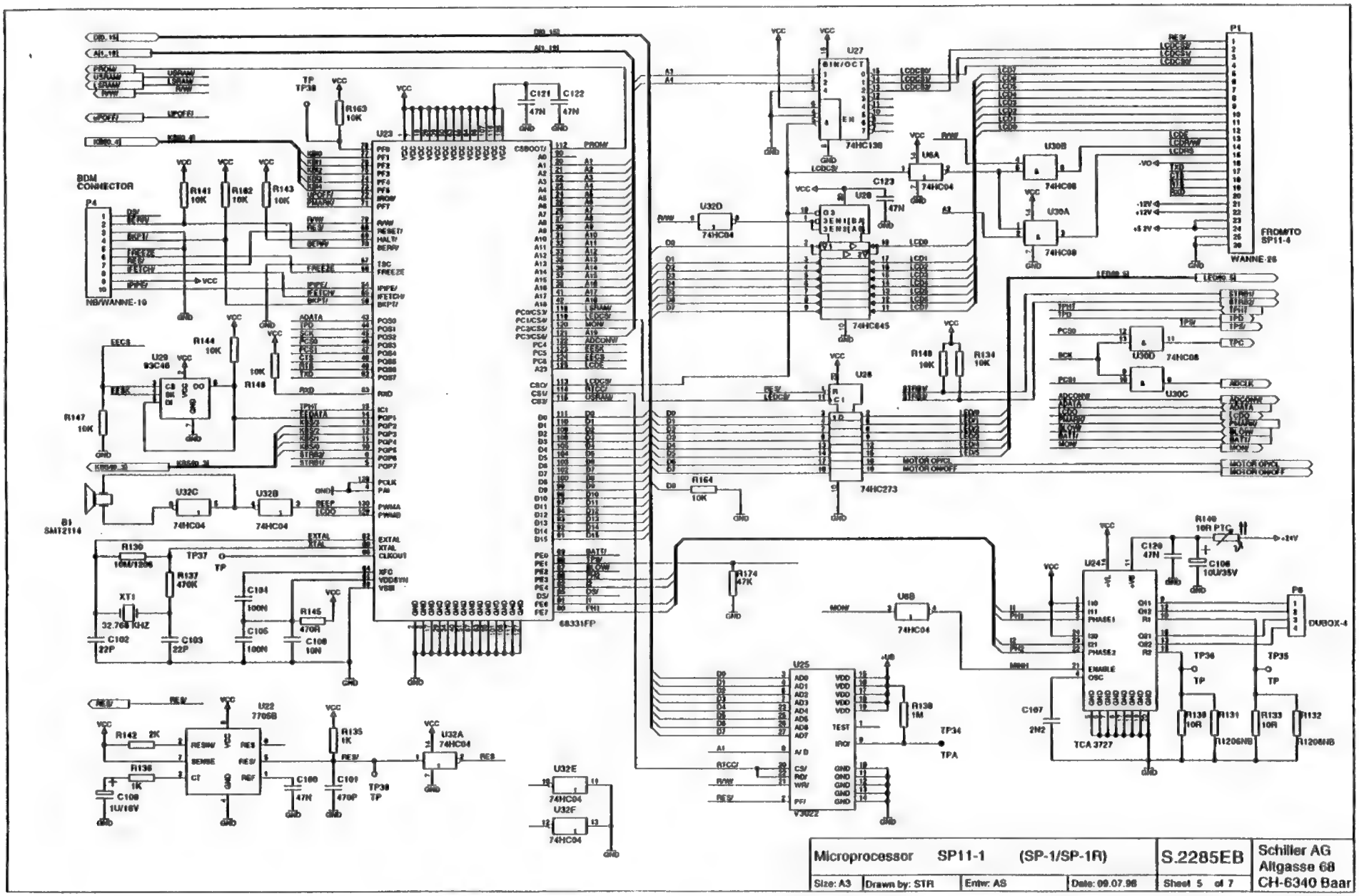


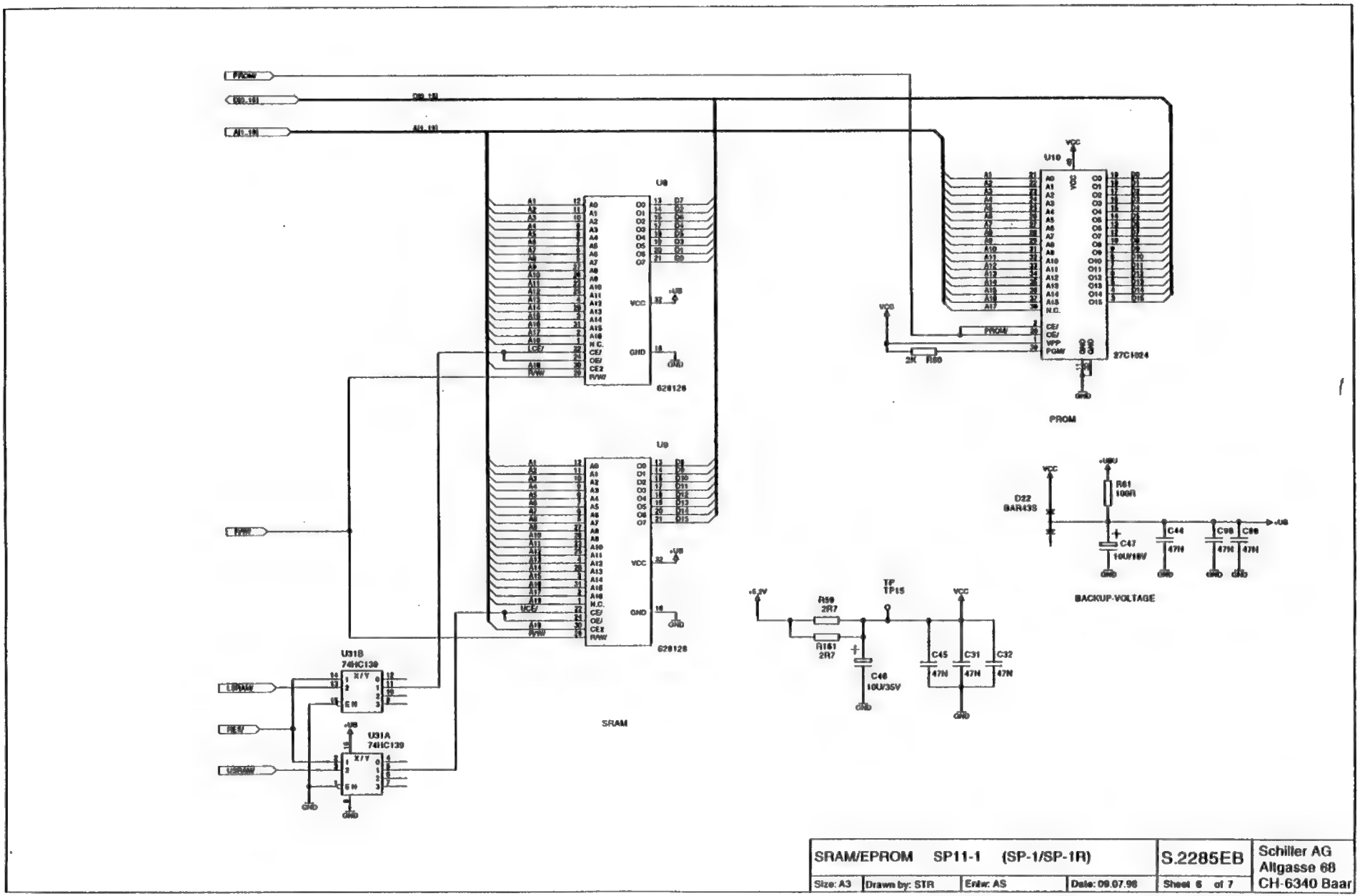
MAINS INP./Batt.Charger SP11-1 (SP-1/SP-1R)				S.2285EB	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: STR	Entw: AS	Date: 09.07.98	Sheet 2 of 7	



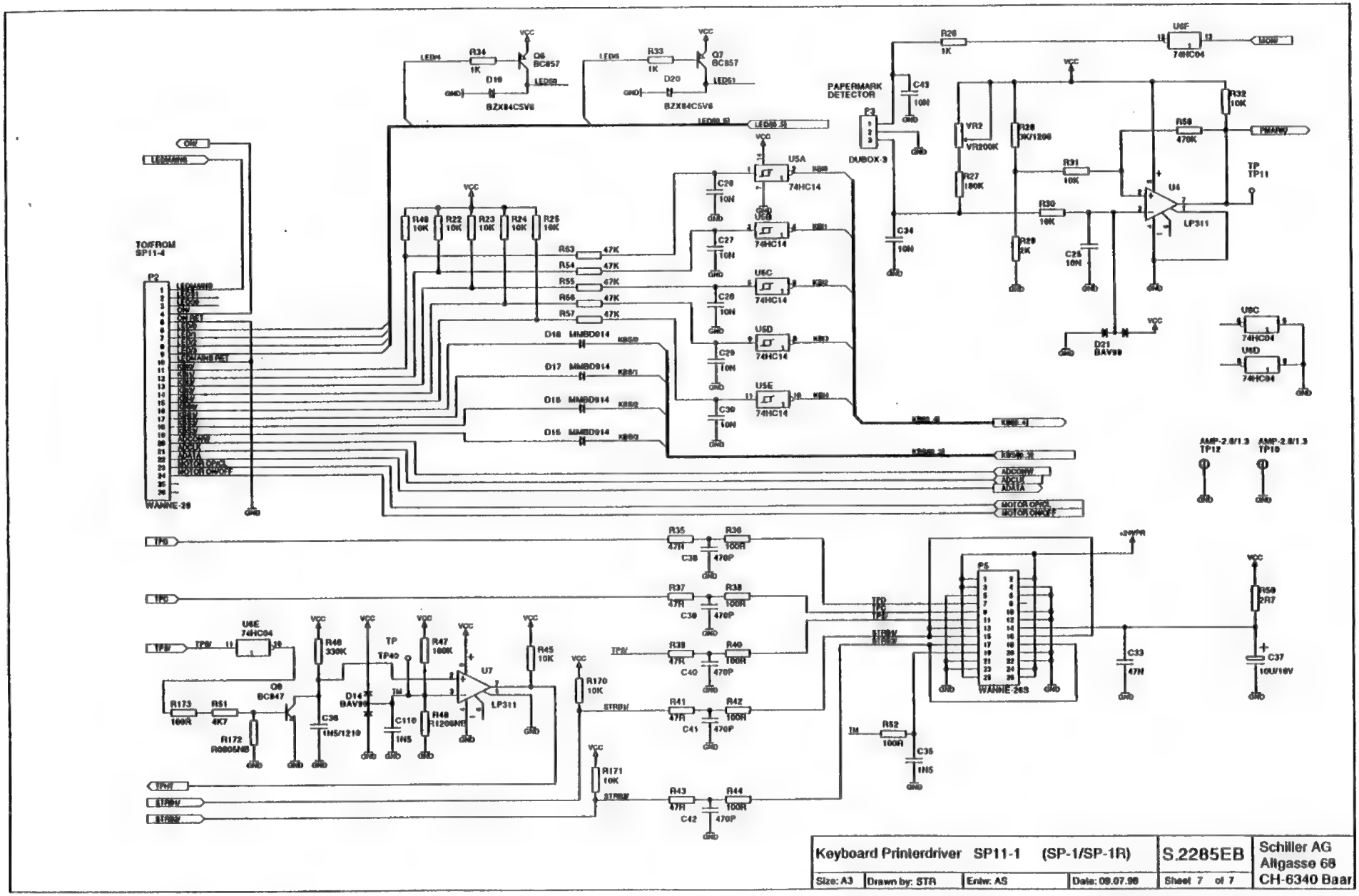
Power ON/OFF +U Backup SP11-1 (SP-1/SP-1R)				S.2285EB	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: STR	Entw: AS	Date: 09.07.98	Sheet 3 of 7	


+US = 10V, +5.2V 1A Last, f = 90kHz
+5.2V/+24V CONV. +/-12V SP11-1 (SP-1/SP-1R)
S.2285EB
Schiller AG
Altgasse 68
CH-6340 Baar

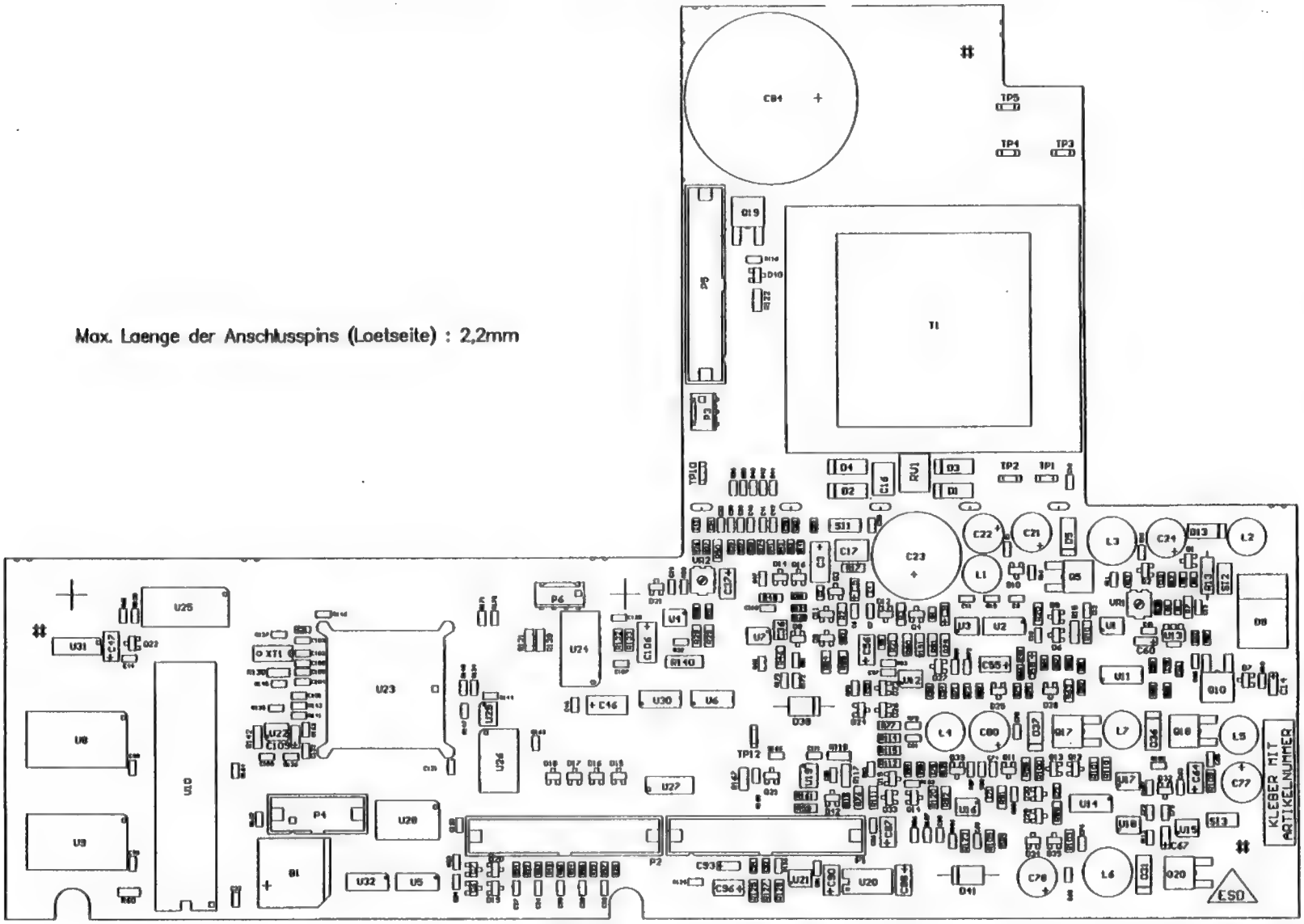

BDM CONNECTOR
P4
NB/WANNE-10
U23
68331FP
U27
74HC138
U28
74HC845
U26
74HC273
U29
93C46
U32C
74HC04
U32B
74HC04
U32D
74HC04
U32A
74HC04
U32E
74HC04
U32F
74HC04
U30B
74HC08
U30A
74HC08
U30D
74HC08
U30C
74HC08
U24
TCA 3727
U25
V3022
U22
7705B
U8B
74HC04
P1
WANNE-26
FROM/TO SP11-4
P8
DUBOX-4
B1
SMT2114
XT1
32.768 KHZ
R130
10M/1206
R137
470K
R163
10K
R141
10K
R142
10K
R143
10K
R144
10K
R146
10K
R147
10K
R148
10K
R134
10K
R164
10K
R174
47K
R145
470R
R135
1K
R136
1K
R142
2K
R138
1M
R140
10R PTC
R139
10R
R131
1206NB
R133
10R
R132
1206NB
C121
47N
C122
47N
C123
47N
C102
22P
C103
22P
C104
100N
C105
100N
C106
10N
C100
1U/16V
C101
470P
C107
2N2
C120
47N
C108
10U/35V
TP37
TP38
TP34
TP35
TP36
TPA
TP
+24V
+12V
-12V
+5.2V
Microprocessor SP11-1 (SP-1/SP-1R)
S.2285EB
Schiller AG
Allgasse 68
CH-6340 Baar
Size: A3
Drawn by: STR
Entw: AS
Date: 09.07.98
Sheet 5 of 7



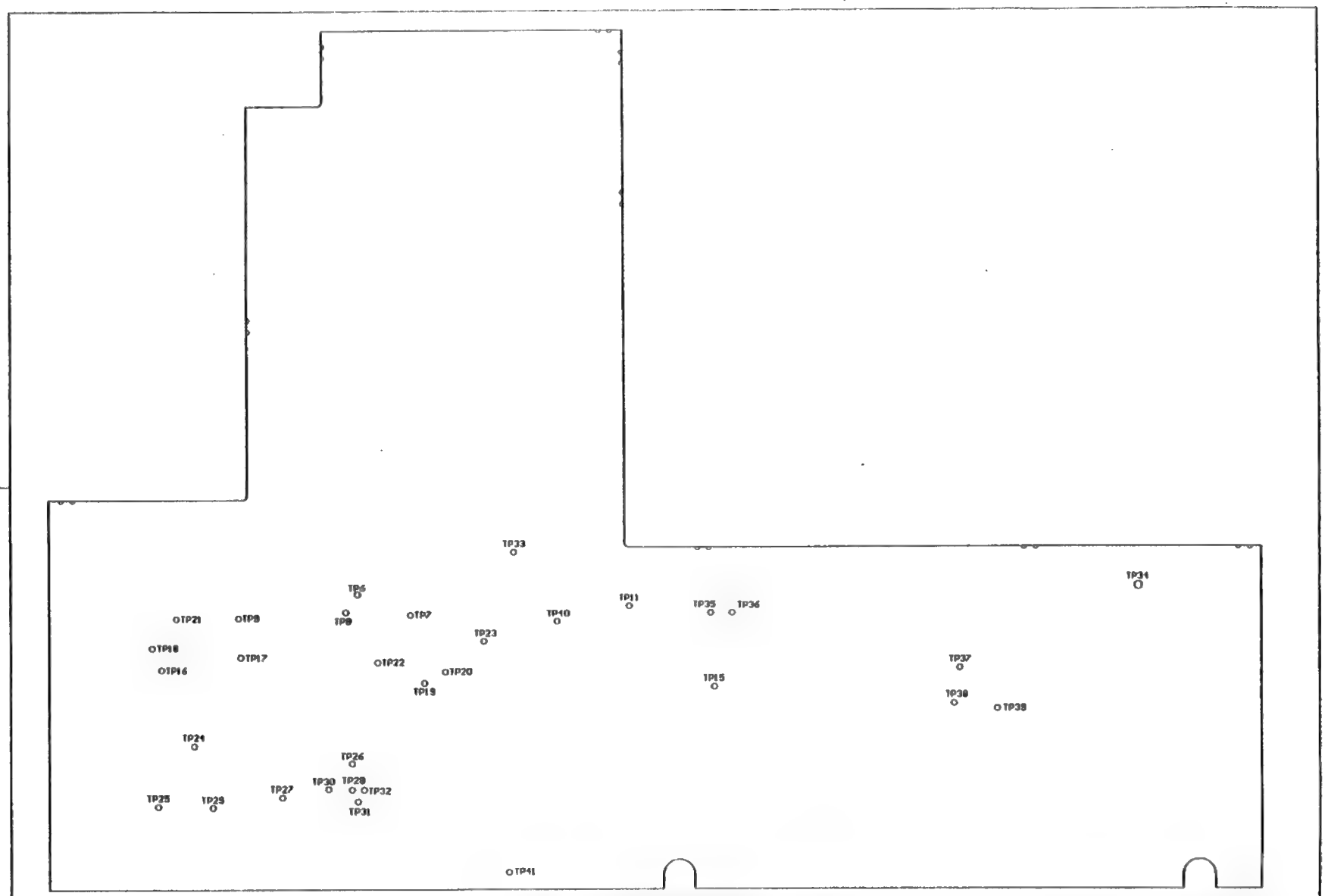
SRAM/EPROM SP11-1 (SP-1/SP-1R)				S.2285EB	Schiller AG Allgasse 68 CH-6340 Baar
Size: A3	Drawn by: STR	Enlw: AS	Date: 09.07.96	Sheet 6 of 7	


PAPERMARK DETECTOR
DUBOX-3
TO/FROM SP11-4
WANNE-26
WANNE-26S
LP311
74HC14
74HC04
BZX84C5V6
BC857
BC847
MMBD914
BAV99
Keyboard Printerdriver SP11-1 (SP-1/SP-1R)
S.2285EB
Schiller AG
Allgasse 68
CH-6340 Baar
Size: A3
Drawn by: STR
Entw: AS
Date: 09.07.98
Sheet 7 of 7

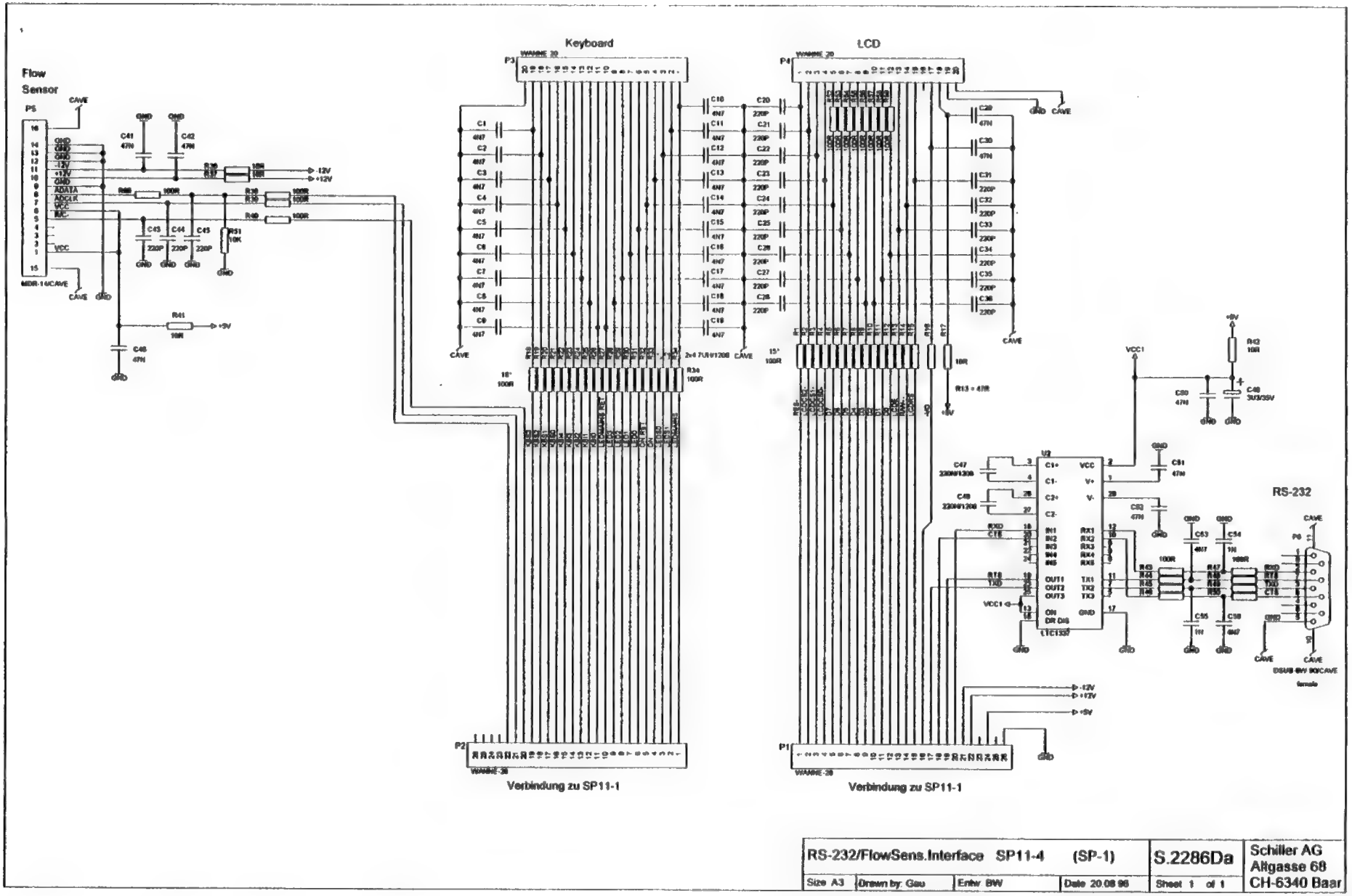
Max. Laenge der Anschlusspins (Loetseite) : 2,2mm

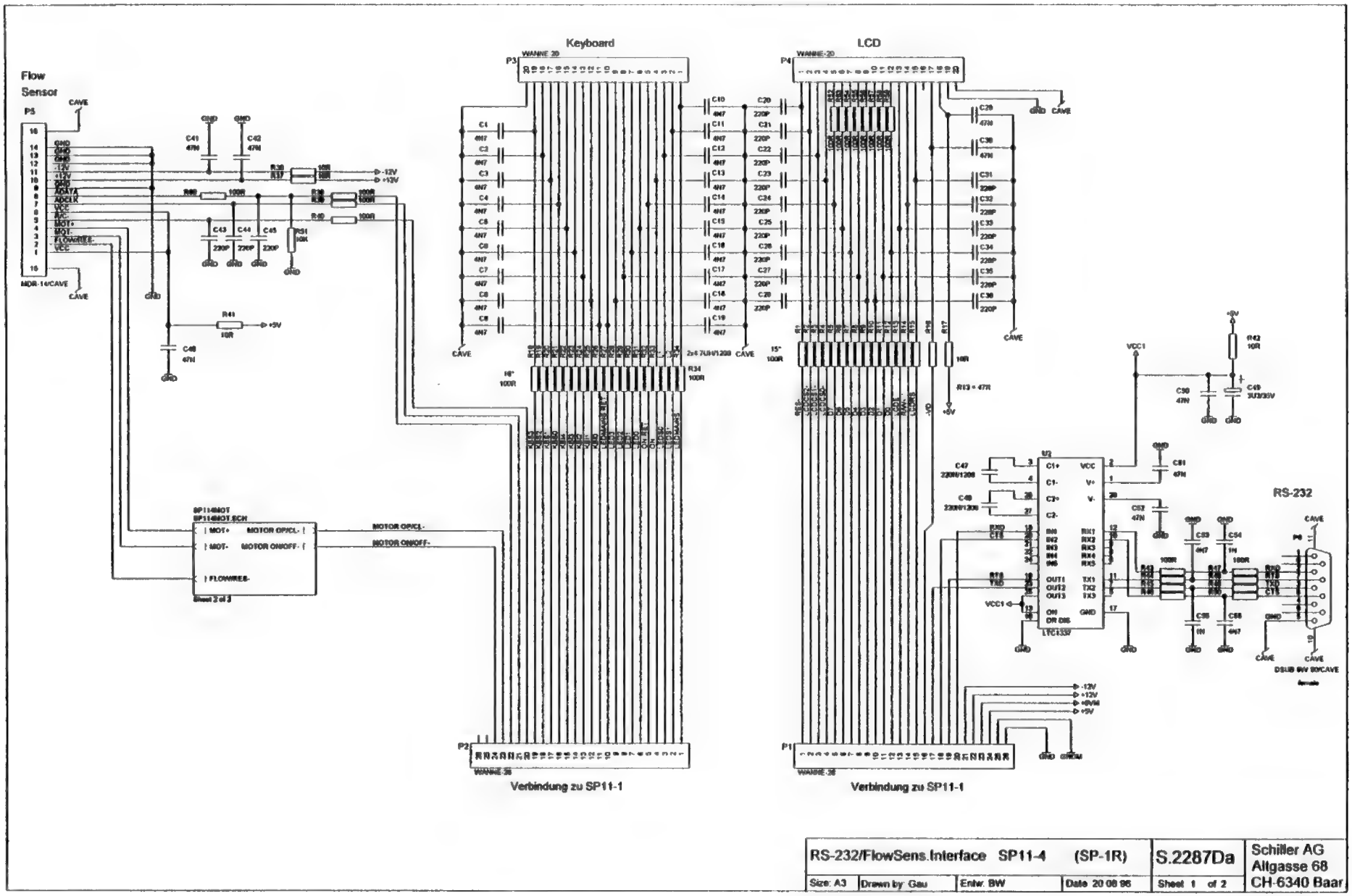


Title: MICROPROCESSOR/POWER SUPPLY SP11-1				D.2285Ea	Schiller AG
Project: SP-1/SP-1R					Altgasse 68
Visum:	Drawn By: Gau	Entw.	Prod.	Date 17.03.98 Sheet 1 of 2	CH-6340 Baar

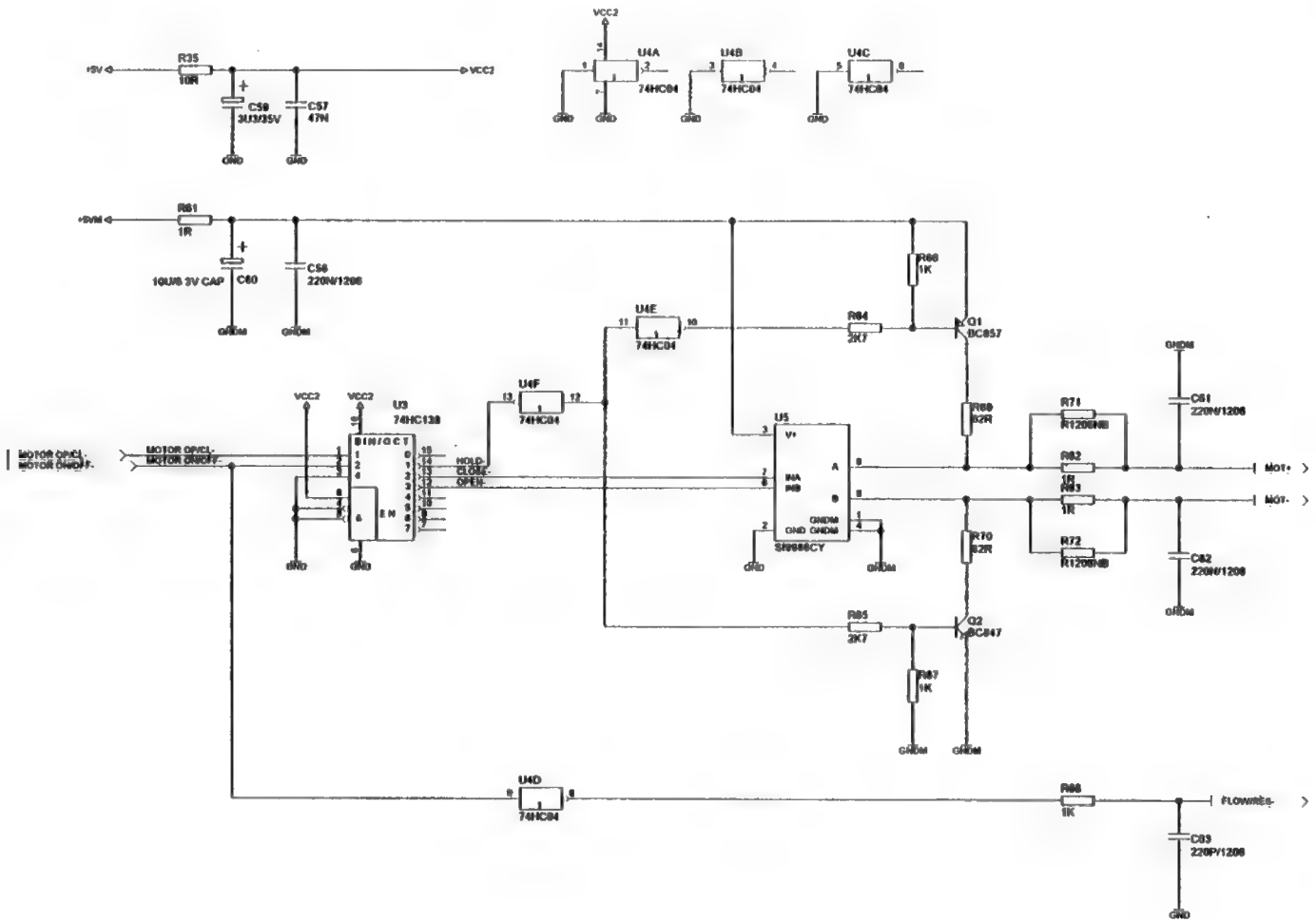


Title: MICROPROCESSOR/POWER SUPPLY SP11-1				D.2285Ea		Schiller AG
Project: SP-1/SP-1R						Altgasse 68
Visum:	Drawn By: Gau	Entw.	Prod.	Date 17.03.98	Sheet 2 of 2	CH-6340 Baar

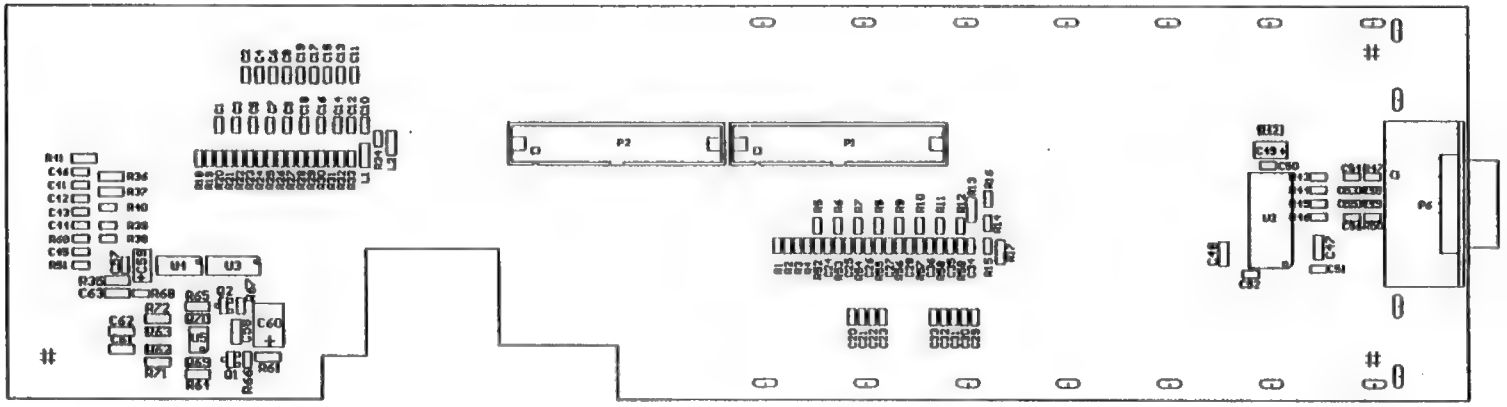

Flow
Sensor
P5
Keyboard
P3
LCD
P4
P2
P1
Verbindung zu SP11-1
Verbindung zu SP11-1
RS-232
RS-232/FlowSens.Interface SP11-4 (SP-1)
S.2286Da
Schiller AG
Altgasse 68
CH-6340 Baar
Size A3
Drawn by: Gau
Entw: BW
Date: 20.08.98
Sheet 1 of 1



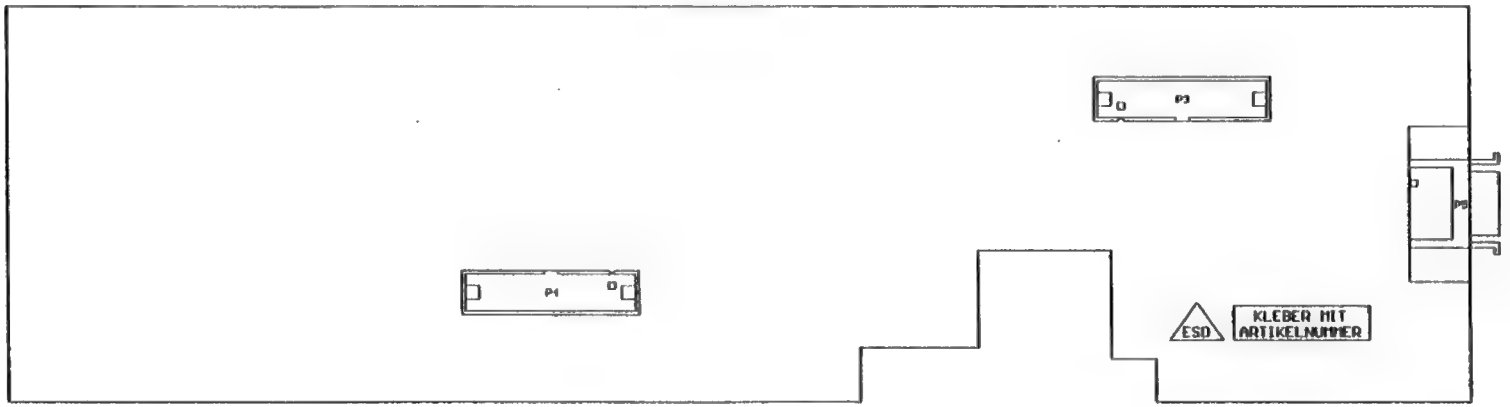
RS-232/FlowSens.Interface SP11-4 (SP-1R)				S.2287Da	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw. BW	Date 20 06 96	Sheet 1 of 2	



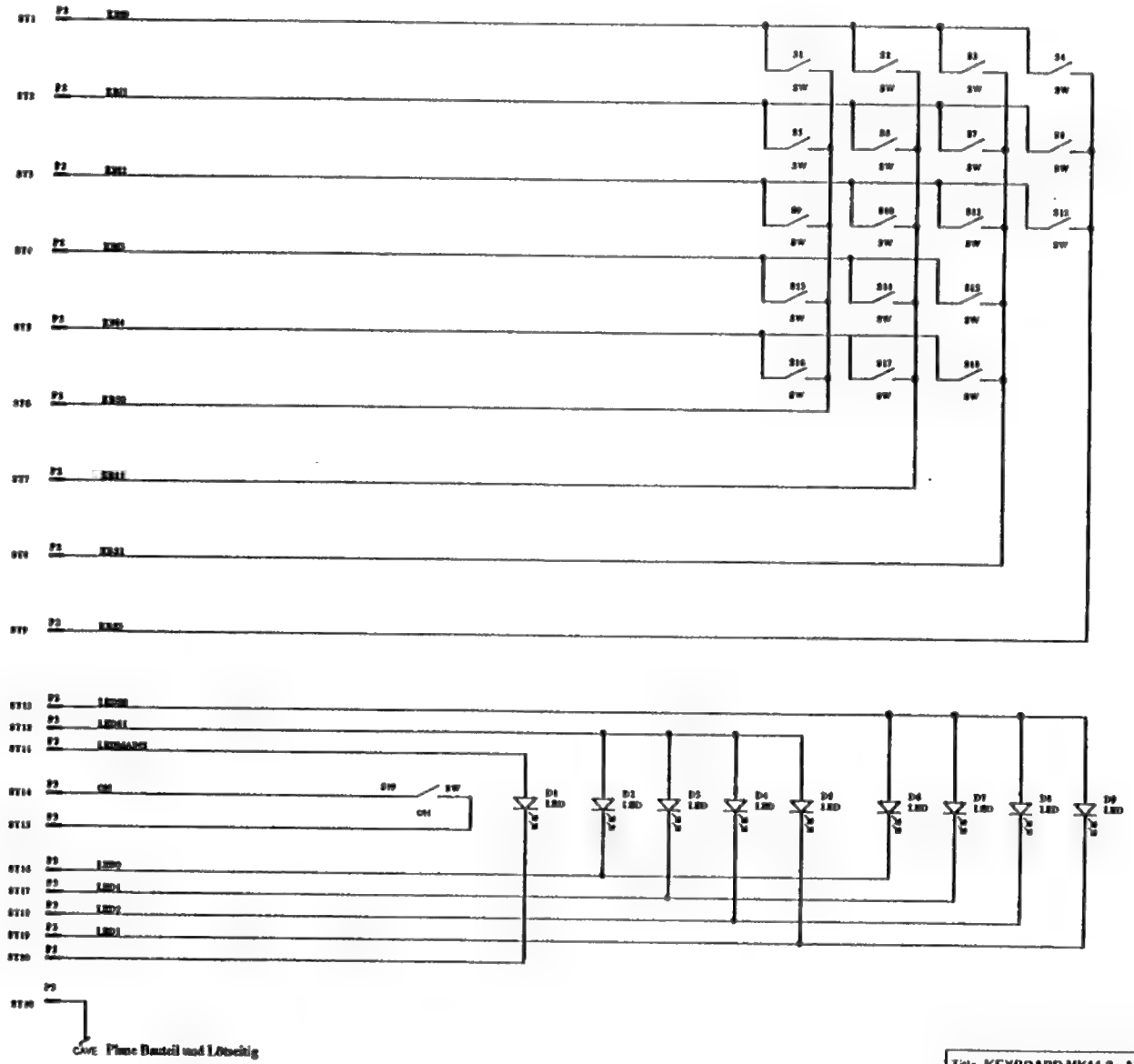
RS-232/FlowSens. Interface SP11-4 (SP-1R)				S.2287Da	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: BW	Date: 20.08.96	Sheet 2 of 2	



Title: RS-232/FlowSens. Interface SP11-4					D.2287Da		Schiller AG Altgasse 68 CH-6340 Baar
Project: SP-1R							
Visum:	Drawn By: Gau	Entw.	Prod.	Date 19.08.96	Sheet 1 of 2		



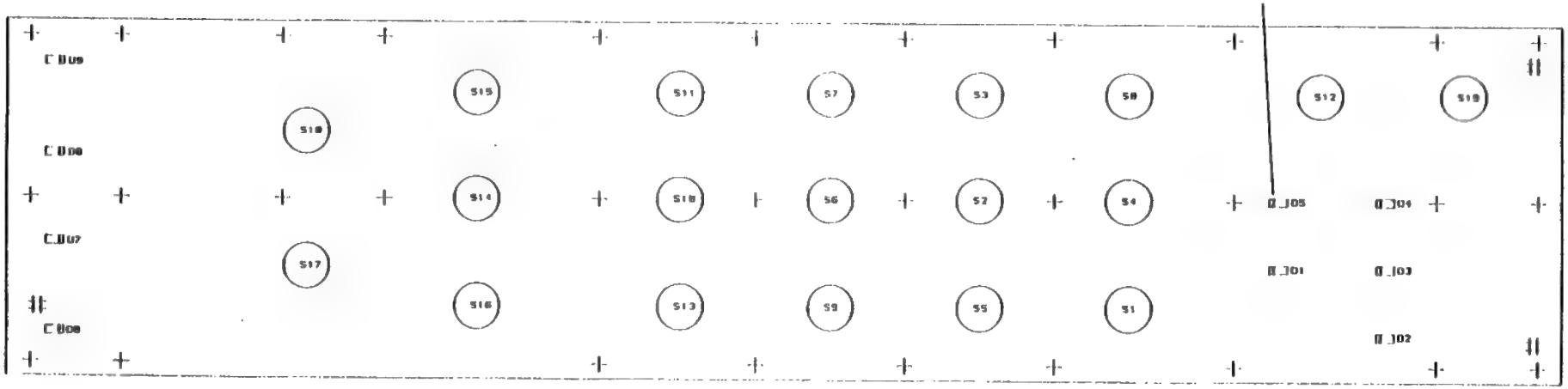
Title: RS-232/FlowSens. Interface SP11-4					D.2287Da		Schiller AG
Project: SP-1R							Allgasse 68
Visum:	Drawn By: Gau	Entw.	Prod.	Date 19.08.96	Sheet 2 of 2		CH-6340 Baar



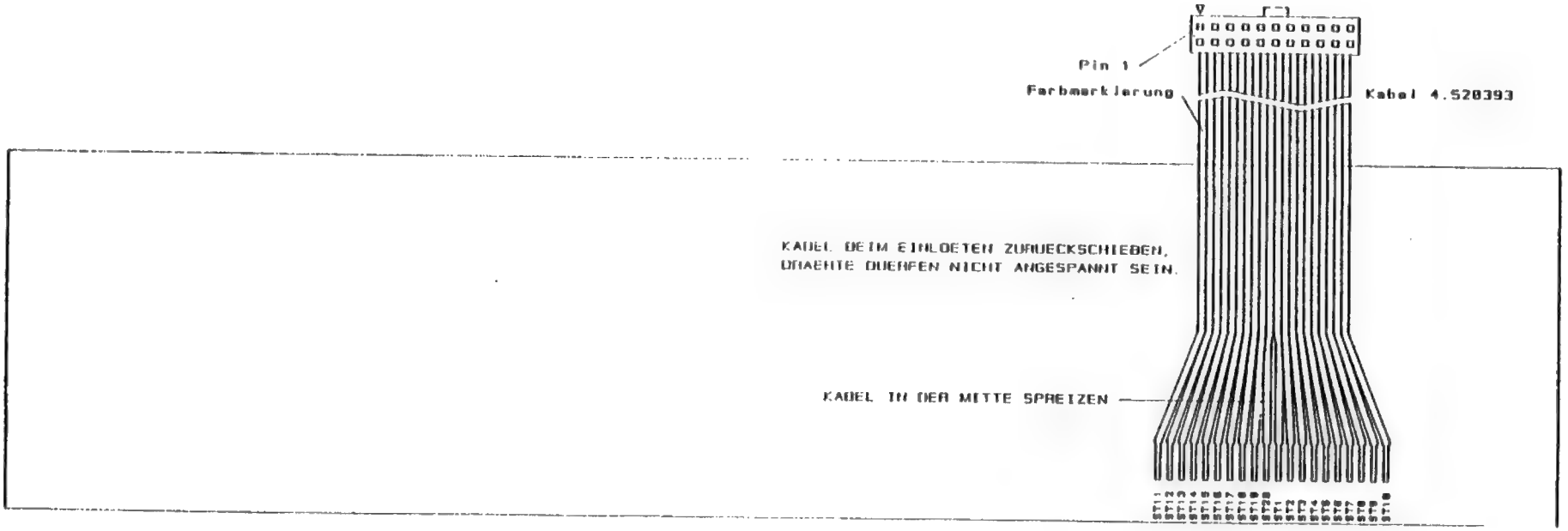
CAVE Plane Bauteil und Lötseite

Title KEYBOARD MK11-3 AT-1			Schiller AG Altgasse 68 CH 6340 Baar Switzerland
Size A3	Nr. S 2422Be	Revision:	
Drawn by Gau		Date 8-Nov-1995	Sheet 1 of 1

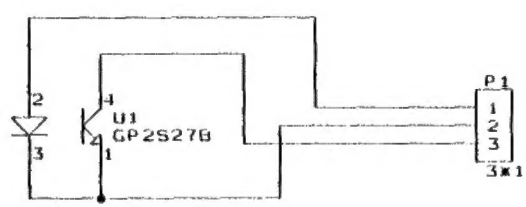
Farbmarkierungen beachten !



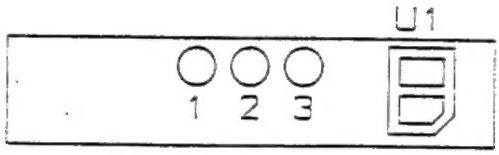
SCHILLER AG Altgasse 68 CH-6340 Baar Switzerland		Visum Gez : STR. Entw : S/J Prod :
Title KEYBOARD MK11-3		AT-1/SP-1
Size Document Number D.2422CA		
Date: 05.11.1996	Sheet	1 of 2



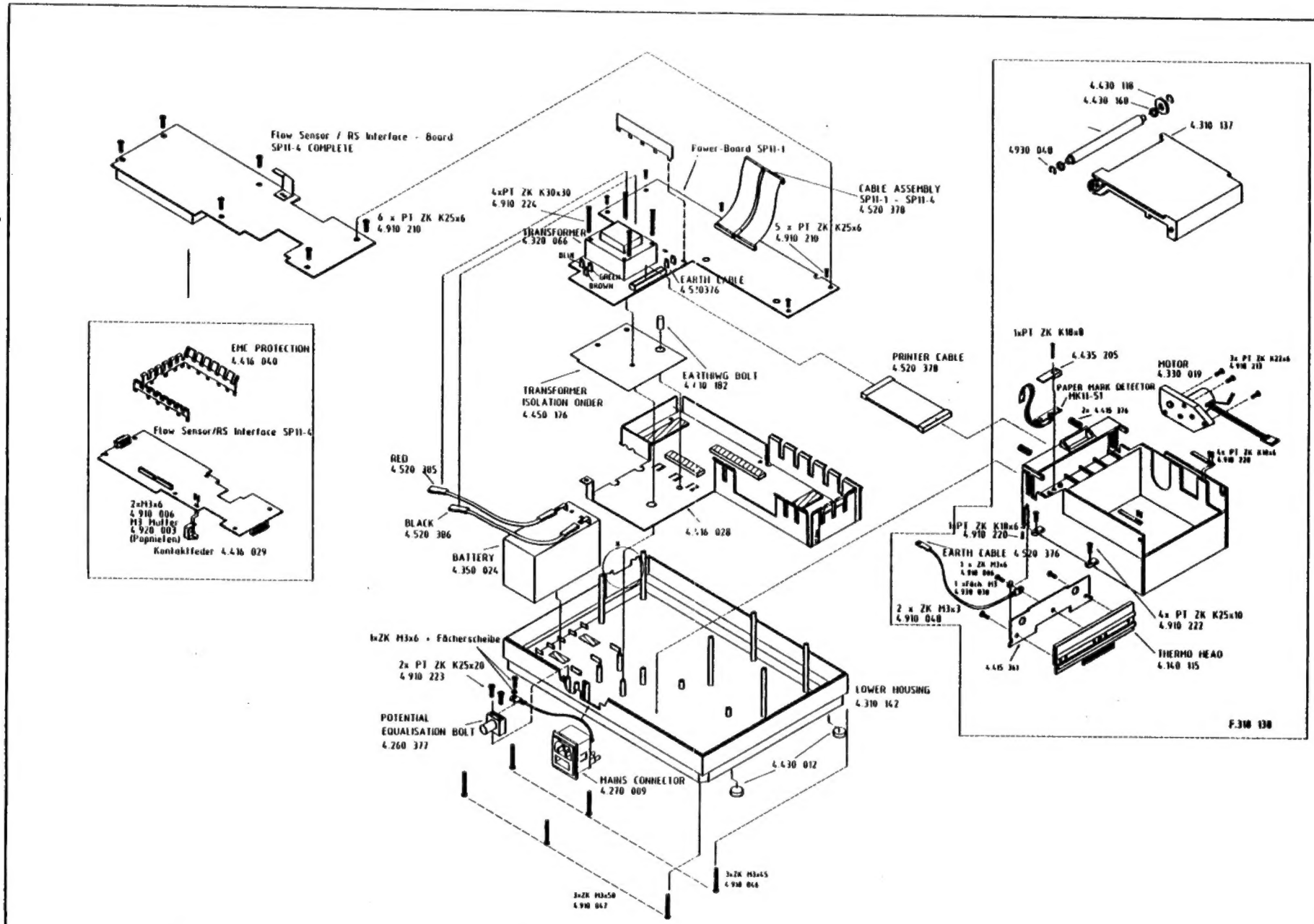
SCHILLER AG Altgasse 68 CH-6340 Baar Switzerland		Visum Gez : STR Entw : BU Prod :
Title KEYBOARD MK11-3		AT-1/SP-1
Size	Document Number D.2422CA	
Date: 05.11.1996	Sheet	2 of 2

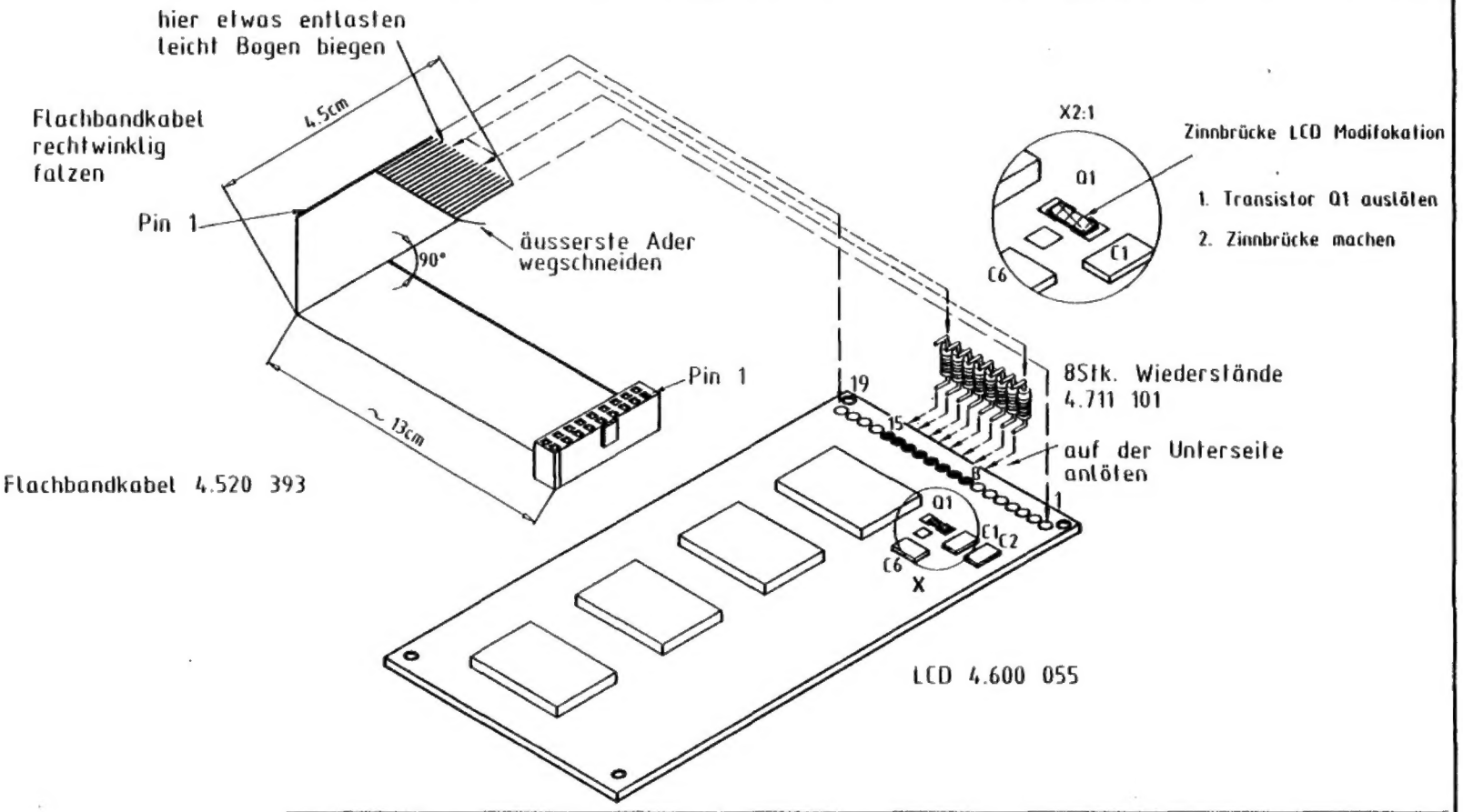


SCHILLER AG Altgasse 68 CH-6340 Baar Switzerland		
Title PM-DECODER MK11-S1 (AT-1 / AT-4) MB		
Size A	Document Number S.24238a	REV
Date: December 13, 1994	Sheet 1 of 1	



	SCHILLER AG Altgasse 68 CH-6340 Baar Switzerland	Visum Gez : STR Entw : Prod : LO
Title	PAPIERMARKEN-DETEKTOR MK11-51 AT-1/4	
Size	Document Number D.2423Ba	
Date: 14.12.1994	Sheet 1 of 1	


Flow Sensor / RS Interface - Board
SP11-4 COMPLETE
6 x PT ZK K25x6
4.910 210
4xPT ZK K30x30
4.910 224
TRANSFORMER
4.320 066
BLUE
GREEN
BROWN
Power-Board SP11-1
CABLE ASSEMBLY
SP11-1 - SP11-4
4.520 378
5 x PT ZK K25x6
4.910 210
EARTH CABLE
4.510376
4.430 118
4.430 160
4.310 137
4930 048
EMC PROTECTION
4.416 040
Flow Sensor/RS Interface SP11-4
2xM3x6
4.910 006
M3 Mutter
4.920 003
(Popnieten)
Kontaktfeder 4.416 029
PRINTER CABLE
4.520 378
EARTHING BOLT
4.410 182
TRANSFORMER
ISOLATION ONDER
4.450 176
RED
4.520 385
BLACK
4.520 386
BATTERY
4.350 024
4.416 028
1xPT ZK K18x8
4.435 205
MOTOR
4.330 019
3x PT ZK K22x6
4.910 210
PAPER MARK DETECTOR
MK11-51
2x 4.416 376
4x PT ZK K18x6
4.910 220
1xPT ZK K18x6
4.910 220
EARTH CABLE 4.520 376
3 x ZK M3x6
4.910 006
1 xFach M3
4.910 030
2 x ZK M3x3
4.910 040
4x PT ZK K25x10
4.910 222
THERMO HEAD
4.140 115
4.435 361
1xZK M3x6 + Fächerscheibe
2x PT ZK K25x20
4.910 223
POTENTIAL
EQUALISATION BOLT
4.260 377
LOWER HOUSING
4.310 142
MAINS CONNECTOR
4.270 009
4.430 012
3xZK M3x45
4.910 066
3xZK M3x50
4.910 067
F.310 130



Pos.	Menge	Gegenstand	Werkstoff		Oberfläche		Bemerkung	
					Gezeichnet	6. Juni 1995	BW/rr	Massstab
					Geprüft	27.7.96		
c	8 Wiederstände 4.711 101 einlöten		25.3.96	HSCH/rr				
b	Kabel neu biegen		8.11.95	RR	BG-Zuordnung	SP-1		
a	Nummer von F.600 055 auf F.911 105 geändert		4.9.95	RR	Ersatz für		Anzahl Blatt	Blatt-Nr.
Index	Aenderung		Datum	Sig.	File: SP1\F911105		A4	

SCHILLER AG
CH-6340 BAAR

Titel: LCD Modifikation / SP-1

Zeichnungs-Nr.: F 911 105c